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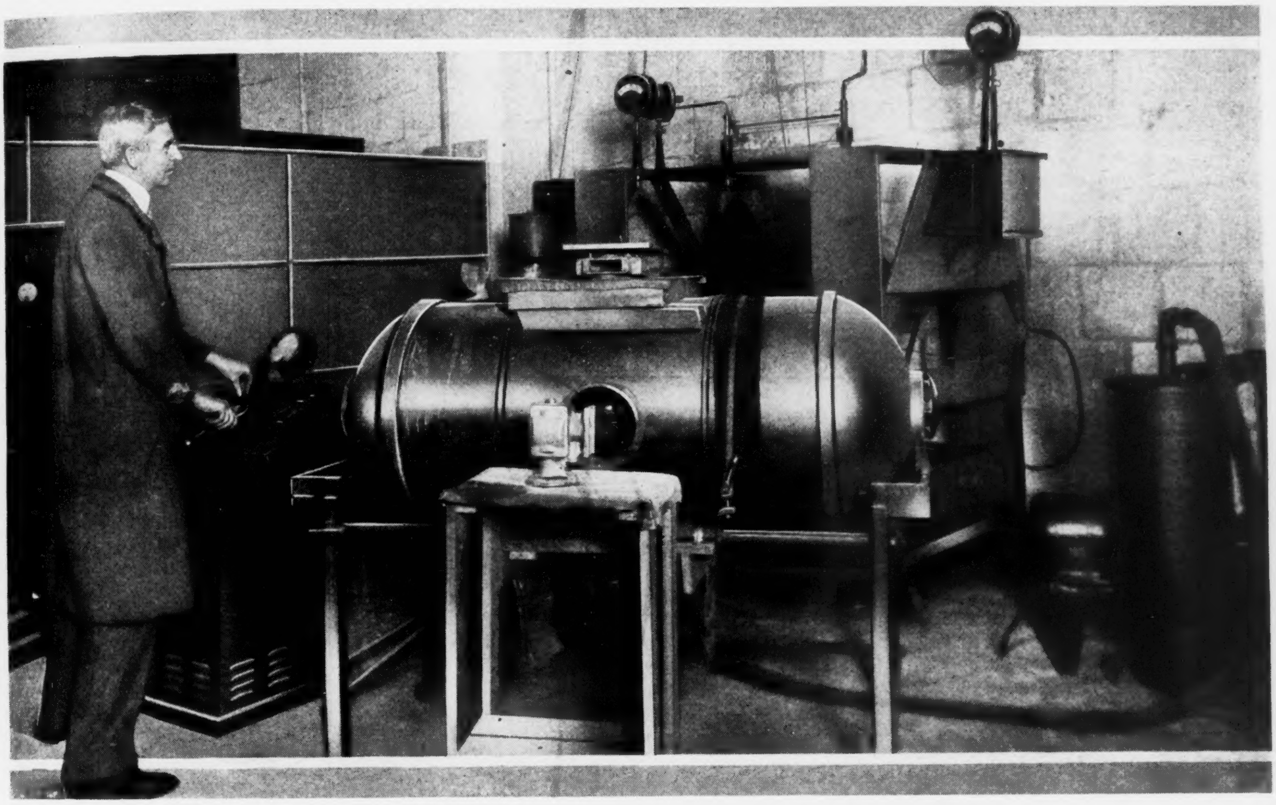


X-Ray Inspection in the Machine Shop

By HERBERT R. ISENBURGER, President, Herbert R. Isenburger, Inc., New York, N. Y.

CAN X-ray inspection be used profitably in the machine shop? This is a question that naturally arises when this new inspection device is mentioned to the makers and users of machine equipment. In many cases it can—in others it cannot; hence, it is always well to consult with competent advisers. In order to give men engaged in mechanical production work a chance to visualize some of the possibilities, with respect to their own problems, some pertinent facts and illustrations are here presented.

Without spending time upon the nature and production of X-rays, we will merely recall that they are of the same general character as light waves, but so short that they readily penetrate all sorts of materials usually opaque to visible light; that they are produced commercially by a very high voltage discharge in a special type of vacuum tube; and that their ability to penetrate materials increases with the voltage, but decreases as the atomic weight of the materials increases. Thus, X-rays produced at 100,000 volts may penetrate satisfactorily an inch of steel, several inches of aluminum or a foot or more of wood, whereas more than 200,000 volts would be required to produce X-rays to penetrate three inches of steel.

The usual way of recording X-rays is by the "shadow picture," or radiograph, formed on a photographic film. As with ordinary photographs, darker regions on the negative or lighter regions on the print mean that more light has passed through the object at that place—that is, the object is more transparent there. With this in mind, there should be no difficulty in understanding the accompanying illustrations.

The X-ray Detects Internal Defects in Castings

Serious waste in the machine shop often occurs because of internal defects discovered in the work after considerable machining has been done. Serious claims for damages are sometimes made, because internal defects in machine parts which were not discovered when building the machine, have caused subsequent failure in service. While these conditions are, perhaps, more prevalent in castings, they also occur in forgings and in bar or plate stock.

Where it is a question of machining large and important castings, X-ray inspection should always be considered. H. H. Lester at the Watertown Arsenal, Ancel St. John in his Long Island City Laboratory, Pullin and Wiltshire at the Woolwich Arsenal in England, and others, have shown that remarkably detailed pictures of all sorts of cast articles can be secured with comparative ease and speed, so long as the greatest thickness does not

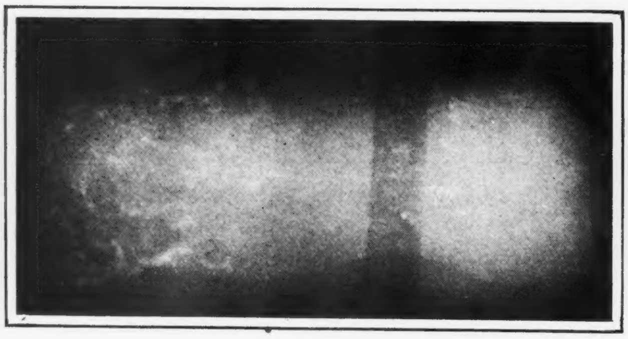


Fig. 1. X-ray Picture of Cast-steel Tee Showing Shrinkage Cracks (Half Actual Size)

Fig. 2. Part of 5-inch Ell Showing a Chaplet, Cavities, and Sand Inclusions (Half Actual Size)

exceed 3 1/2 inches of steel or its equivalent. Some typical pictures by Dr. St. John, who is now consulting physicist for the X-ray Division of Herbert R. Isenburger, Inc., illustrate this.

Fig. 1 shows a portion of a large cast-steel tee intended for a high-pressure steam plant. The jagged light streaks indicate shrinkage cracks, which were so numerous that the casting was rejected. Not only did this save useless machining cost, but it also averted a serious accident, which would probably have occurred had this casting been put in service. Fig. 6 is a photograph (actual size) of a fragment taken from this region when the fitting was broken up for visual examination.

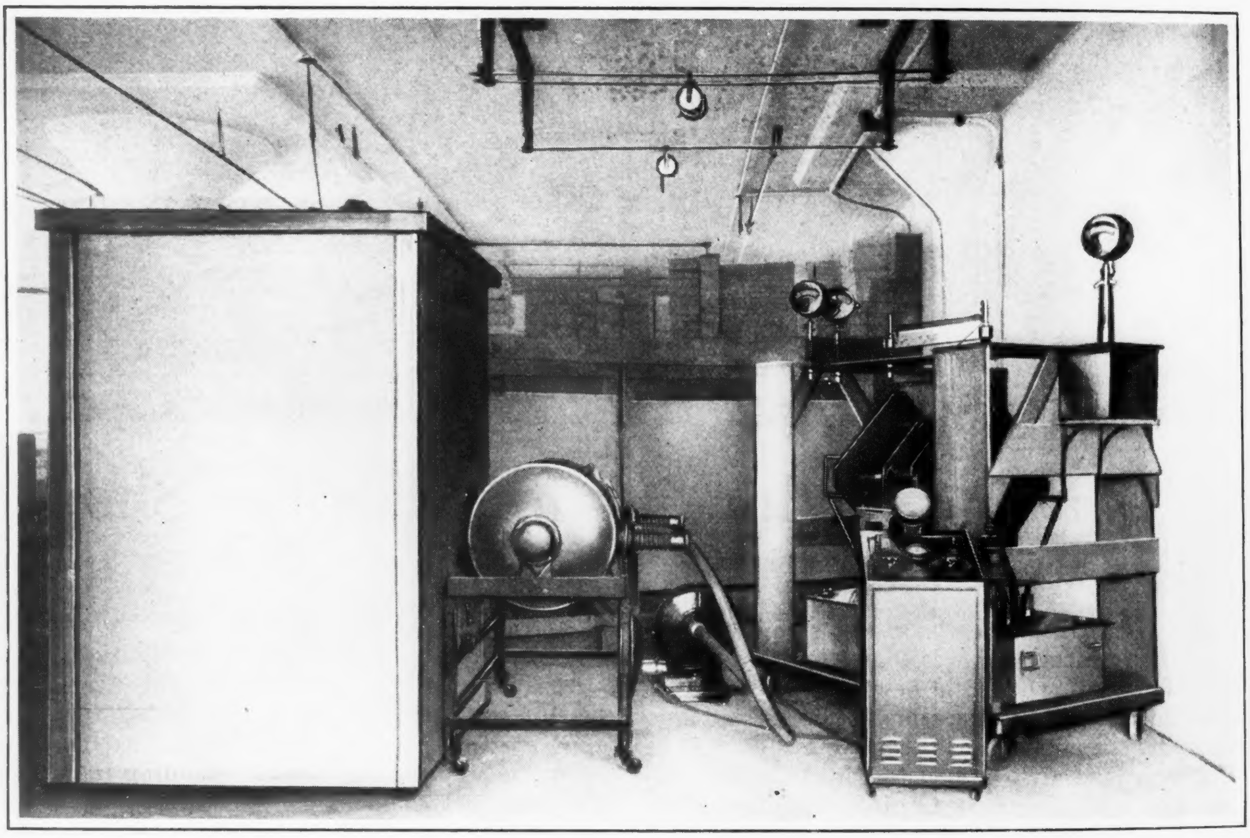


Fig. 3. A View in the X-Ray Photographic Laboratory of Dr. Ancel St. John in Long Island City, N. Y.

Fig. 2 is a portion of a 5-inch ell for the same steam plant, showing a chaplet, a large cavity near

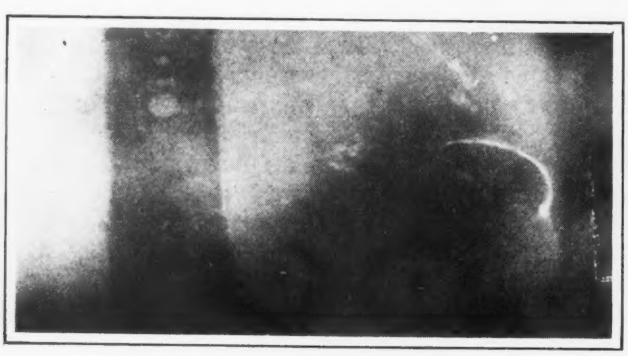


Fig. 4. X-Ray Picture of 3-inch Ell Showing Crack (Full Size)

Fig. 5. A 7-inch Ell Showing Cavities that may Later Develop Leaks (Half Actual Size)

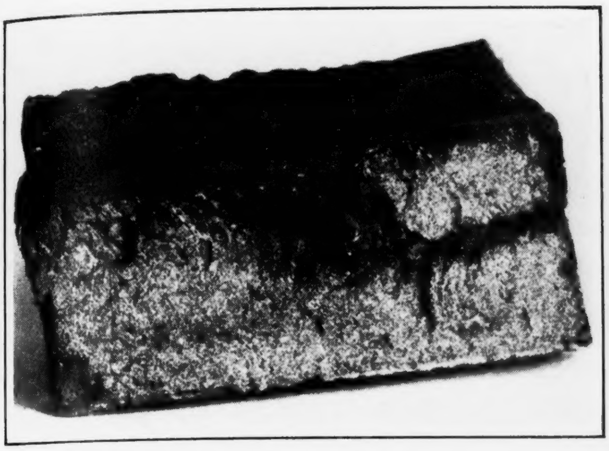


Fig. 6. Photograph of a Fragment of the Fitting X-rayed in Fig. 1 (Full Size)

it, some sand inclusions, and a series of cavities, one being more than an inch long. This, too, was rejected with corresponding savings.

Fig. 4 is a portion of a 3-inch ell for this plant which was selected by the customer's inspector as particularly good, after applying ordinary inspection tests. The picture shows a sharply defined crack starting from a small cavity or inclusion. The crack shows all the characteristics of a cold-working crack as distinguished from the shrinkage cracks of Fig. 1. Its location was marked with crayon on the outside of the ell, and it was found where indicated when the fitting was sectioned. Moreover, micrographic examination of the material adjacent to the crack showed that it had been cold-worked. The fitting was probably ruined in the very hydrostatic test that proved it good.

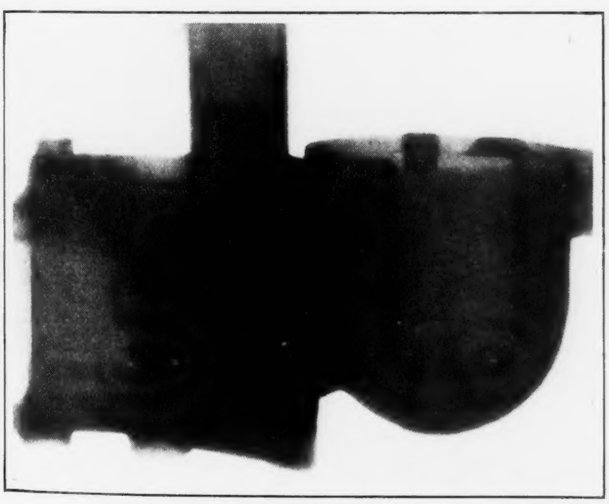


Fig. 7. An Aluminum Die-casting Almost Entirely Free from Porosity (Half Actual Size)

Fig. 5 illustrates conditions that were considered permissible in a 7-inch ell for this plant. The chaplet is well fused in, a small sand inclusion, a cavity about 1/4 inch in diameter, and a string of small cavities near the flange are all near the surface and leave plenty of sound material. The rectangular area with a fairly well defined "handle" indicates a somewhat larger cavity with a connecting tube that passes almost through the wall. This casting was put in service with the understanding that it would probably begin to leak in a few months. Certain conditions shown in Fig. 5 would have been objectionable had they occurred where they would have been encountered in machining.

These four radiographs were each made at about 200,000 volts, with exposures of less than 30 seconds. The illustrations, of course, present horrible examples, and must not be considered as repre-

Fig. 8. A Zinc Die-casting Weighing About Six Pounds, Showing Very Slight Porosity (Half Actual Size)

sentative of castings as a whole. In fact, X-ray examination has shown that with proper foundry procedure, castings can be made surprisingly free from defects.

Fig. 7 is a radiograph of an entire aluminum die-casting, which is almost completely free from even minor porosity. There should be no hesitation in proceeding with a casting of this kind. Fig. 8 is a radiograph of an entire zinc die-casting weighing about 6 pounds. It shows very slight porosity, none of which would be objectionable.

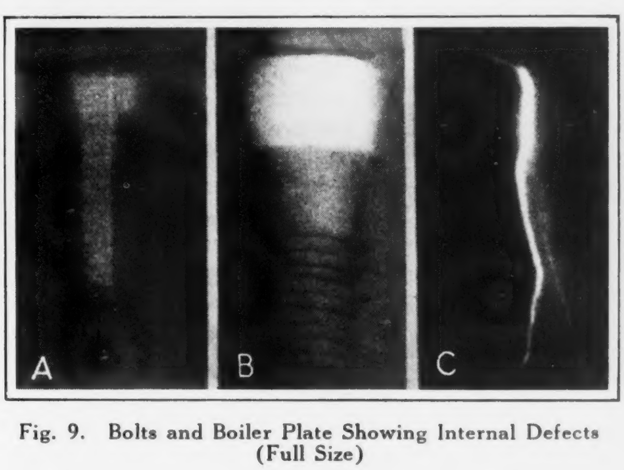


Fig. 9. Bolts and Boiler Plate Showing Internal Defects (Full Size)

Forgings and bar or plate stock may contain cavities and inclusions in the original ingot which are subsequently flattened or drawn out, as, for example, the slag filament through the bolt cut from the hexagonal bar shown at *A* in Fig. 9, or the inclusion in the head of the cold-headed bolt shown at *B;* or they may contain cracks and cavities developed by over-strain, as illustrated in the portion of 1 1/2-inch boiler plate at *C*, or as shown by Pullin and Wiltshire in their book "X-rays, Past and Present," Fig. 33.

Cost of Equipment Required for X-ray Inspection

The equipment used in making these pictures is shown in Fig. 3 and in the heading illustration. It consists of a high-voltage power plant capable of producing 280,000 volts, an X-ray tube mounted in a lead-covered steel drum to prevent the escape of X-rays except through predetermined openings, and an exposure cabinet provided with movable lead screens to surround the object under examination. In the heading illustration, these screens have been removed, so as to show the castings in position. In addition, there is a photographic dark-room. With this equipment, articles ranging from sheet rubber 20 mils thick to cast steel 3 1/2 inches thick have been examined in routine practice.

The cost of X-ray installations comprising all the necessary equipment set up, ready for use, ranges from about $1000 for a plant suitable for thin steel, light alloys, fiber and wooden articles, to about $7500 for a plant suitable for anything up to 3 1/2-inch steel, or the equivalent in absorbing power. The cost of operation depends upon the character and quantity of work done. In many cases, an installation would pay for itself in a year.

* * *

GERMAN MACHINERY EXPORTS

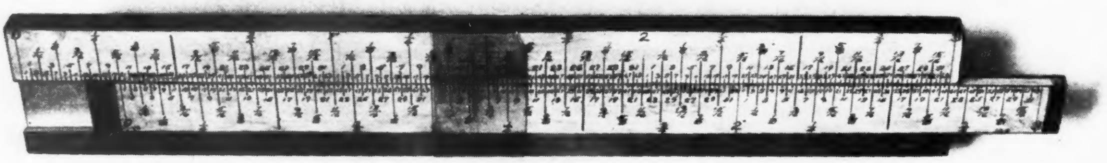
German official statistics show that in 1927 the German machinery exports to the United States (amounting to 13,528 metric tons) were almost equal in tonnage to the United States machinery exports to Germany, which amounted to 13,429 metric tons. The value of the machinery exported from the United States, however, was greater than the value of the machinery imported into this country. Of Germany's total machinery exports, 70 per cent go to other parts of Europe; 12 per cent to Latin America; 7 per cent to Asia; about 5 per cent to the United States and Canada, with the remainder scattered. The total exports of machinery of all kinds amounted to 458,000 tons, valued at 870,000,000 marks (approximately $210,000,000).

SLIDE-RULE FOR ADDING FRACTIONS

By J. STILES BEGGS

A slide-rule for adding fractions, like the one shown in the accompanying illustration, will be found very useful by designers and detailers. It is especially useful in checking drawings. The adding of several fractions consisting of sixty-fourths, thirty-seconds, etc., to obtain an over-all dimension is the kind of routine work that most designers, draftsmen, and checkers dislike. Each fraction has to be mentally reduced to the last common denominator, and when the sum is obtained, it may be necessary to reduce the resulting fraction to a fraction having a smaller denominator as, for instance, 40/64 to 5/8.

By a simple setting of the slide on the rule shown in the accompanying illustration, it is possible to add fractions quickly. The principle on which the rule operates is that of placing two scales side by side in such a position that the lengths corresponding to the two fractions to be added can be measured by a third scale. Similarly, it is possible to subtract fractions by measuring the distances between the lengths representing the two fractions.



Slide-rule for Adding and Subtracting Fractions

The rule consists of two similar 3-inch scales. The divisions on the rule are made four times the actual size of the divisions that they represent, in order to facilitate reading. In other words, the smallest divisions of each scale, which represent sixty-fourths of an inch and are numbered up to sixty-four, are actually 1/16 inch long. The lower scale is mounted on a slide, and a runner is provided for adding together a number of fractions, which involves several settings of the slide.

Assume, for instance, that 5/16 and 19/32 are to be added: Set the zero point on the lower scale under the 5/16 division on the upper scale—see illustration. Now move the runner along until the hair line is directly over the 19/32 division on the lower scale. The sum of the two fractions (29/32) is then read off under the hair line on the upper scale. If it is desired to add another fraction to this sum, the zero point on the slide is again drawn up to the hair line of the runner and the adding operation repeated as described.

If 19/32 is to be subtracted from 29/32, set the 19/32 division on the lower scale under the 29/32 division on the upper scale. Above the zero point of the lower scale, read off the difference on the upper scale, which is seen to be 5/16. If the scales are correctly laid out on tracing cloth or tough paper and then cut out and glued to wooden members as shown, and given a coat of clear shellac, a fairly serviceable ruler will be the result.

Contributory Infringement of Patents

By LEO T. PARKER, Attorney at Law, Cincinnati, Ohio

PROBABLY the most common source of patent litigation is contributory infringement. Often it is an indirect infringement surrounded by obscurity which, to the average misinformed manufacturer, seller, and user, apparently renders the indulger practically safe from prosecution. However, contributory infringement of a patent may be proved even where it is practiced under the most carefully prearranged plans which, at first observation, appear to present perfect protection against apprehension and prosecution of the various guilty parties.

Infringing acts of two or several persons may be considered collectively by the Courts, in determining whether the parties are liable as infringers, in exactly the same manner as when similar infringing acts are performed by a single person. And when contributory infringement has been proved, all the guilty persons involved are liable for payment of the profits earned plus a reasonable amount of damages incurred by the patentee.

What is contributory infringement of a patent? There are many acts that may be construed as contributory infringement, and it is quite possible for a person unfamiliar with patent law to become liable to contributory infringement without any intention on his part of infringing. Any act that ultimately may result in an infringement of a patent may be construed as contributory infringement. Many phases of the subject are presented by Mr. Parker in the present article, and a large number of interesting cases are cited to illustrate important points. Manufacturers and machine designers alike will find a study of this article well worth the few minutes required.

Acts Comprising Contributory Infringement of Patents

In a recent case (186 F. 637) a concise explanation of the acts comprising contributory infringement was given as follows: "The legal principles governing contributory infringement exist where one knowingly concerts or acts with another in an unlawful invasion of a patentee's rights. If such assistance is given by furnishing an essential part of an infringing combination, and the part furnished is adapted to no other than an infringing use, this makes the one who furnishes the assistance a contributory infringer. On the other hand, if the part furnished is adapted to other and lawful uses, in addition to infringing uses, then an intent to furnish for infringing use must be established before the furnisher can be held for contributory infringement."

In other words, contributory infringement consists of any act, or series of acts, that ultimately results in infringement of a patent. For example, where two or more persons manufacture different parts of a patented device and assemble the elements into an infringing device, all are liable, irrespective of whether the parts are made in the same or in widely separated localities.

Unauthorized Adoption of One Part of a Patented Device Is Infringement

Any person who makes one part of a patented device and sells or uses it may be liable for infringement. However, since this phase of the law relating to contributory infringement presents so many different angles, probably a review of the leading and higher Court decisions involving the different points will convey the desired information better than mere explanation.

In Lenk vs. Hunt-Lasher Co. (14 F. (2nd) 335), it was disclosed that a patent had been issued that included a blow-torch which had been claimed with the wick included as one of the elements. A manufacturer sold wicks and recommended that they be used in the patented blow-torch, believing that his wick was sufficiently different from the wick shown in the patent to avoid infringement. However, since the substituted wick was broadly covered by the patent claims, the manufacturer was held liable as an infringer.

In another recent case, Belknap vs. Wallace Addressing Co. (12 F. (2nd) 597), a manufacturer was held liable as a contributory infringer when he sold stencil cards to be used in an addressing machine on which a patent had been issued including the cards as one of the patentable elements.

In Drinking Cup Co. vs. Errett (300 F. 955), it was disclosed that a patent protected a paper drinking cup vending machine, in combination with the drinking cups that were especially adapted for use with the machine. A manufacturer of paper products made and sold cups to owners of the vending machines. This manufacturer was held liable as an infringer, and it is interesting to observe that the Court said:

"Without cups these machines cannot be used . . . Anyone who sells cups with the knowledge that they may be used as an infringement, therefore, directly contributes to the eventual infringement and does so with his eyes open." In cases of this kind the manufacturer, seller, and user of the part that contributes to the ultimate infringement are liable.

Device Capable of Infringing Use Is An Infringement

At various times manufacturers have endeavored to avoid infringement by making and selling a device which may or may not be used as an infringement. If, however, the manufacturer or seller instructs the purchaser how to use the device to effect infringement, both the seller and the purchaser are liable as contributory infringers.

For instance, in one case (274 F. 607), a patent had been issued on a molding machine which had a trough that could be slid outward for filling molds

with molten metal. A manufacturer made and sold a molding machine having a trough that could be either rotated or slid outward to effect satisfactory operation. In selling the machine, the manufacturer demonstrated its rotatable operation, but did not explain that the trough was slidable. This manufacturer was held liable and, of course, the user also was an infringer. The Court said: "Where defendants manufacture a device capable of an infringing use and sell it with the intent that it shall be so used, they infringe the patent, even though their device is capable of a non-infringing use, and even though they go through the form of instructing that it shall be used in a non-infringing way."

Parts Adaptable to Lawful Use

In many instances, common parts, such as levers, gears, frames, and the like, are used by the purchasers to construct or repair patented machinery. The law is well established that both the manufacturers and users of the parts are liable as infringers if the manufacturer sells the parts with the knowledge that the purchaser intends using them for the purpose of avoiding the payment of royalties to patentees. But if the parts are purchased from manufacturers, or other sellers, who are not informed of the intended infringing uses of the purchaser, only the latter is liable.

For example, in the case of Whitney vs. New York Scaffolding Co. (243 F. 180), it was disclosed that a manufacturer sold parts of a patented device not in any way intending or anticipating that they should be used in constructing an infringing machine. The Court held the manufacturer not liable, and explained this phase of the law as follows: "The question in contributory infringement is whether or not the defendant made or sold his improvement with intent or purpose of aiding another in the unlawful making, selling, or using of a third person's patented invention . . . But the mere fact that it is capable of such a use is not sufficient to establish such an intention or purpose, where the evidence is that the machine and its parts were expressly fitted for use in a rightful way without aiding in any such infringement, and there is no evidence that the defendant even knew that it ever was sold or used in such a way as to aid others in infringing the patented invention."

However, as already stated, if a manufacturer makes a part of a patented device, knowing that it is only adapted to be used in a patented combination, he will be presumed to intend that the part shall be used to effect infringement of the patent. In other words, it is the duty of the person who is offering for sale one or more articles, which he intends shall be used in combinations, to see to it that such combinations as he thus promotes and induces are lawful and are not infringements of patents. (224 F. 452).

Manufacturers and sellers of articles marked "Patent Applied For" are guilty of contributory infringement when they make and sell part of a device for which they know a patent is about to be issued to some one else. This phase of the law was thoroughly considered in a recent case in which a manufacturer was sued for making fountain-pen holders to fill an order obtained several months prior to the issuance of a patent to the inventor of a similar holder. Most of these holders were made before the patent was actually issued. The Court held all persons involved in making, selling, or using any of the holders liable for infringement.

No Liability for Selling or Using Parts Not Covered in Patents

On the other hand, neither a manufacturer, seller, nor user of a part is liable for infringement of a patented device if the part is not specifically covered by the claims of the patent. It is important to know that a machine patent consists of the drawings, specifications, and claims. The drawings and specifications must show and describe at least one operative form of the invention. However, if the specification is properly prepared, the claims may be sufficiently broad to protect innumerable forms and modifications quite different from the one form of the device described.

Then, too, the claims may be weak or specifically applicable to only one form and construction of the invention. Under the latter circumstances, any person or firm is privileged to make and sell any parts of the patented machine that are not included in the claims, even though such parts are clearly shown in the drawings and described in detail in the specification. For example, in National vs. Symington Co. (230 F. 821), it was disclosed that a manufacturer made and sold parts of a patented machine, but these parts were not mentioned in any of the claims. The Court promptly held that infringement did not exist, even though these parts, in combination with the machine, were clearly shown and described in the patent.

It is important to know that it is immaterial for what reason the claims of a patent may insufficiently protect the invention. The established law on this subject is well expressed by a higher United States Court (77 F. 432), as follows:

"The purpose of a claim is to notify the public of the extent of the monopoly secured to the inventor, and while it is a notice of his exclusive privileges, it is no less a notice, upon which every one has a right to rely, that he disclaims, and dedicates to the public, any combination or improvement . . . which he has not there pointed out and distinctly claimed as his discovery or invention. Every one has the right to use every machine, combination, device, and improvement not claimed by the patentee, without molestation from him."

When Sellers of Articles Marked "Patent Applied For" Are Liable as Infringers

Contrary to the opinion of the majority of persons, a manufacturer may be guilty of contributory infringement when he makes and sells part of a device for which he knows a patent has been applied and is about ready to be issued. This phase of the law was thoroughly discussed in Barrett vs. Sheaffer (251 F. 74). The facts of this case are that in August a manufacturer accepted an order for 10,000 holders of fountain pens, upon which he secured a payment of $5000. He immediately proceeded to make and deliver several hundred of the

holders, knowing that his product was similar to the holder on which an inventor had applied for a patent. The patent was issued on November 24, but was not delivered to the inventor until a few days later. On November 25 the manufacturer delivered 108 holders to the purchaser, in addition to the others that were delivered previous to the issuance of the patent.

After the patent was delivered to the patentee, he sued the manufacturer for damages and profits on all the holders made and delivered previous to the issuance of the patent, as well as on the 108 holders delivered November 25. During the trial, testimony was introduced to prove that, when he accepted the order for the holders, the manufacturer knew that the holders would be used to make fountain pens that later were held to infringe the patent although, of course, he did not know at that time that the patent would contain broad claims. The Court held all persons involved in making, selling, and using any of the holders liable as co-infringers.

* * *

LONG LIFE AND CARE OF MOTORS

By JOHN J. MARSHALL

In a plant in California there are in the neighborhood of 165 direct-current motors and three direct-current motor-generator sets. The motors range in size from 1/4 to 50 horsepower, most of them operating at from full load to 25 per cent overload for eight hours a day under severe service conditions. During the last twenty-six years, only five armatures have burned out, and these were in motors built during the war and installed during the last ten years. Practically no repairs to the armatures of motors installed in 1902 have been made.

The three motor-generator sets have been in constant operation for twenty-four hours a day, 335 days a year, for twenty years. During this entire period there has never been a shut-down due to any fault in the machines. None of the bearing linings have ever been replaced and none of the commutators have ever been turned off.

The motor commutators are as smooth as glass, and those on the generators are only slightly grooved, due to the type of brush and the heavy pressure used. The commutators have been kept in condition by grinding with a commutator grinding stone. From all indications, they will last forty years longer. The only item of expense during the twenty years, outside of the regular maintenance—brushes, oil, and cleaning—was the replacing of the leather belting in the flexible coupling, which was done about every six years. To protect this belting from the action of acid fumes, it is soaked in pure neat's-foot oil for about ten hours and then allowed to drip and air-dry. The total cost per machine was $36. The credit for this performance belongs to the builders, because the machines have received only ordinary, although regular, attention.

The motors are divided into groups so arranged that each motor is inspected once a month, when minor defects are corrected. As far as more serious defects are concerned, however, the motors are operated until it is impossible for them to be operated any longer without damaging them. They are overhauled and cleaned once a year during a shut-down period.

The commutators on the motors are never turned off if it can be avoided, but are kept in excellent condition by a light application of a suitable size of grinding stone at the time of inspection. The commutators of the motors on the motor-generator sets have the grinding stone applied to them once a week. Two grades of stones are used, "finish" and "polish" grades. The largest stones used are 3 by 2 by 6 inches in size. The 2- by 6-inch edge is held against the commutator by hand, no special holder or appliance being used. It might be thought that these commutators would be greatly out of true. The last test with a dial indicator showed them all to be true within 0.003 inch.

No lubricant of any kind is used on the motor commutators. Pure petroleum vaseline is used on the generator commutators. This is applied twice in each eight-hour shift with a thin paint brush, 1 1/2 inches wide.

* * *

The striking growth of the French machinery industry is indicated by a report issued by the Department of Commerce, Washington, D. C. The value, figured on a gold basis, of the French machinery output in 1926 was three times that in 1913. The value of machine tools built in France was four times that previous to the war.

The machinery output in 1926 is valued at about $130,000,000. This great increase is due to four principal factors: (1) The country's increased capacity for iron and steel production, resulting from the acquisition of Alsace-Lorraine; (2) the growth of French industries in general; (3) the depreciated exchange value of the franc; and (4) the resulting low labor costs.

The exports and imports of machinery into France show a striking difference from pre-war conditions. In 1926, the imports, measured on a tonnage basis, were 43 per cent less than in 1913, while the exports rose 268 per cent. In 1913, Germany supplied most of the machinery imports into France, or 46 per cent. In the same year the United States supplied only 6 per cent, while in 1926, the United States' share had risen to over 18 per cent, while the German participation had decreased to 28 per cent. The three chief sources of supply of machinery imports into France in the order named are Germany, Great Britain, and the United States.

Reducing Labor Turnover

A well thought out policy for hiring and retaining employes is the cornerstone on which many organizations have built their success. Large labor turnover seriously handicaps a manufacturer, and indicates dissatisfaction among many of the workers. Careful consideration of the reasons for frequent changes among the employes in a plant may reveal conditions that can be easily remedied, to the mutual benefit of employer and employes. The article to be published in June MACHINERY, "How We Reduced Our Labor Turnover," describes what was accomplished by a large concern in the Middle West. Several causes of high labor turnover that often escape notice are pointed out, and the means employed for overcoming the difficulties encountered are described. Every shop manager, superintendent, and foreman will find this article of value, because it is based on experience.

Salvaging Dies that Fail to Work

By H. C. CHARLES

QUITE often a slip is made in the design of a die, jig, or fixture which results in the loss of considerable labor and material. Thousands of dollars worth of dies are thrown into the scrap heap in many large plants due to mistakes in designing or making the working drawings. When this happens, generally someone is reprimanded and repetition of the trouble may be temporarily avoided. Too often, however, the dies are simply thrown into the scrap heap, when by a slight reworking they could be reclaimed.

A case of this kind came to the writer's notice not long ago. A die had been designed for bending a piece of flat bar stock to the shape shown at *A*, Fig. 1. The die, as it was designed, is shown at *A*, Fig. 2. By referring to Fig. 1, it will be seen that the flat bar of steel is bent into a U-shape and has two holes on each side. These holes must register across the piece; that is, the holes in one side must be directly opposite those in the other side.

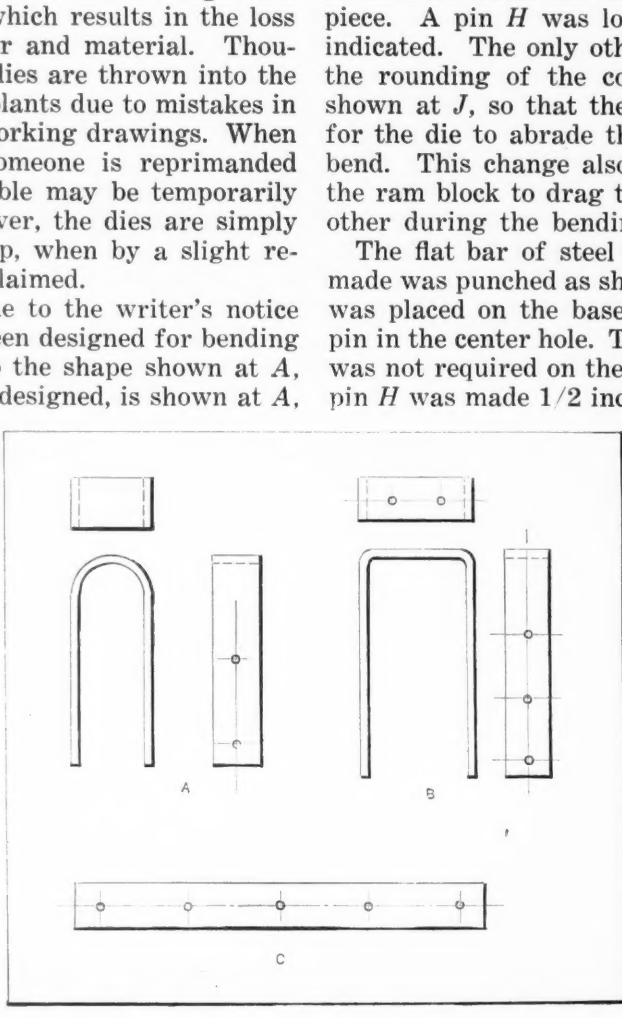


Fig. 1. Examples of Work Bent on Salvaged Dies

The die was designed for use on a bulldozer. The ram die *C*, Fig. 2, is provided with a recess *D* intended to enclose the part *E* on the base block *F*, with sufficient clearance to receive the work. The base block was provided with a baseplate and an adjustable gage *G*. The straight piece of stock is laid across the lip of the base block with one end against gage *G*. The piece is bent by the action of the ram block closing on the baseplate.

The trouble with this die was that the stock was pinched tighter on one side of the die than on the other, resulting in the unequal bending of the piece so that the holes would not match. The hand work required to reclaim the piece made the cost prohibitive. The dies, which cost $98 to produce, were about to be thrown on the scrap heap when it was decided to try them out again after making some slight changes. The die, as it appeared after the changes were made, is shown at *B*, Fig. 2. The quality and quantity of work produced after these changes had been made proved to be entirely satisfactory.

How the Die was Changed to Overcome Faults

The first step in making the changes was to produce a hole in the stock at the center of the portion to be bent. This was found feasible, as the hole would not affect the functioning of the piece. A pin *H* was located in the base block as indicated. The only other change on the dies was the rounding of the corners of the ram die, as shown at *J*, so that there would be less tendency for the die to abrade the work when starting the bend. This change also reduced the tendency for the ram block to drag the work to one side or the other during the bending process.

The flat bar of steel from which the piece was made was punched as shown at *C*, Fig. 1. The piece was placed on the base block of the die with the pin in the center hole. The gage shown at *G*, Fig. 2, was not required on the changed die. The locating pin *H* was made 1/2 inch in diameter, and the hole punched in the stock was 9/16 inch in diameter. The hole in the stock was slightly closed on the pin, but not sufficiently to cause any trouble in the removal of the work from the die.

Difficulties in Bending U-shaped Piece

In the production of the piece shown at *B*, Fig. 1, difficulties similar to those overcome in producing the piece shown at *A* were encountered. The piece shown at *B* was also produced from flat stock and bent to a U shape. However, the corners of this piece were required to be square. Eight holes were punched in the straight bar, three on each side, and two 1/2-inch holes in the center for locating the end of the piece for bending. The three holes in the sides of the bent piece are required to register in order to permit inserting bolts which hold a casting fitted between the prongs of the piece.

The die designed to produce the bend in this piecé is shown at *A*, Fig. 3. It consists of the plain ram block *C* and the base block *D*. The base block is provided with a lip at *E* and an adjustable gage *F*. The straight bar to be bent is laid across the lip of the base block on its edge, with the end against gage *F*. In this position, when the ram came forward to make the bend, the piece was often shifted slightly. This change in the position of the piece, in addition to the stretching of one side more than the other, threw the holes out of line on the finished work. Considerable hand work was then necessary in order to make the pieces suitable for use.

Another Example of Die Improved by Slight Changes

To correct the trouble, the dies were changed over as shown at *B*, Fig. 3. The ram die was machined at *K* to provide relief between the die face and the work. Two 2-inch hardened steel rollers *H* were set in the die to engage the stock and avoid abrading the work. Drawing of the stock one way or the other was thus prevented. The gage *F* shown in view *A* was eliminated, and two pins *J* were set in the base block, as shown in view *B*, for locating the work. The pieces produced with this die met all the requirements of the inspection department without any hand work.

Many cases like those described could be mentioned. Some of the common errors found in the design of dies could be avoided by having the drawings checked over by one who has carefully observed the action of steel when subjected to similar bending operations. It is exceedingly difficult and practically impossible in some cases to set up dies in a bulldozer so that drawing of the stock to one side or the other will be avoided. For this reason it is essential that some definite means be provided for holding the stock in exactly the correct position while the work is being bent or formed. Various ingenious devices have been utilized for holding the stock. Such devices are usually of the clamp type, but clamps are generally cumbersome and often slow up production. In the example shown, the addition of clamps would have resulted in but slight improvement. Whenever possible, simple gaging and holding devices, such as illustrated, should be used.

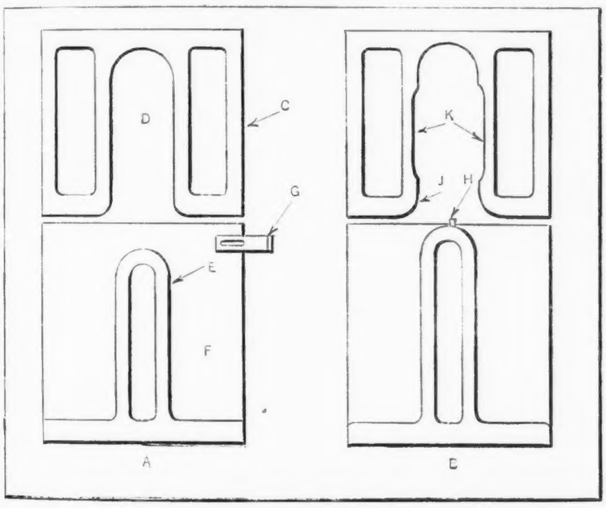


Fig. 2. (A) Faulty Bending Die; (B) Corrected Die

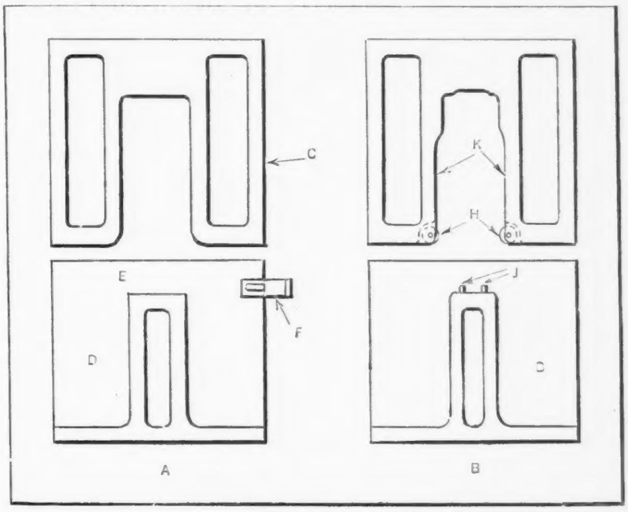


Fig. 3. Views Showing Die before and after Salvaging

A common error in designing bulldozer dies is illustrated in the examples shown at *A* in Figs. 2 and 3. The error is the result of the belief that there must be a bearing between the die and the work for the full length of the bent portion. Attention is called to the clearances *K* provided in the worked-over or reclaimed designs. The providing of clearance spaces as shown eliminates some of the machining operations and therefore reduces the cost of the dies. They also permit the dies to press the stock around the bends where heavy pressure is needed in order to avoid excessive springback.

Another point that may well be mentioned here is the wear that usually takes place at the points that engage the work and the portions around which the work is bent. Some designers allow the plain cast-iron or cast-steel structure to take the wear at these points, with the intention of having these points machined later to receive hardened steel inserts. Whether or not this procedure is economical depends on the size of the body and the amount of stock that must be removed to accommodate the inserts.

In the case of the dies described, this procedure would have proved economical, as the dies were urgently needed and the making of the steel inserts would have caused delay. It will be noted, however, that in neither case did the designer allow sufficient stock in the ribbing of the blocks to provide for inserts. It may, therefore, be necessary to obtain an entirely new set of blocks when the castings have become worn.

* * *

A WELDED RAILROAD BRIDGE

According to Gilbert D. Fish, consulting structural engineer of the Westinghouse Electric & Mfg. Co., the bridge that carries the Boston & Maine Railroad over the canal at Chicopee Falls, Mass., is the first railroad bridge in the world to be erected by the arc welding process. There are no rivets or bolts in the bridge. Mr. Fish states that the outstanding advantage obtained by the use of arc welding was a saving of approximately 33 per cent of the tonnage of steel required. This saving is secured in two ways: In the first place, the size of many of the truss members, connecting parts, and floor stringers has been decreased without reducing their strength in the completed structure, because there is no weakening due to holes punched or drilled through the members; and second, many connecting parts and lattice bars can be omitted in a welded structure.

No records as to the behavior of welded railroad bridges over long periods of time are in existence. For this reason, the Chicopee bridge is of great interest to engineers, as it is expected to furnish important information on the subject of the action of welded joints in severe service. With any newly developed art, like that of arc welding, the more accurate service data that can be collected, the better for the industry.

Common Errors in Machine Design

By HERBERT W. CABLE

USUALLY the part that costs most in developing a special-purpose machine is making a model that will work. Often the mechanical actions and mechanisms are not properly designed until the unsatisfactory operation of the first model has made evident the necessity for completely changing the original design.

Machines costing thousands of dollars often prove incapable of performing the work for which they are intended, and large sums have been lost by investors in vain attempts to make such machines function satisfactorily. Cases of this kind naturally cause the manufacturer to doubt the designer's ability to successfully produce any new automatic machine that may be proposed. There are numberless opportunities for labor-saving devices which manufacturers would undertake to produce, if only they could be shown that satisfactory designs could be developed at a reasonable cost.

Failure of a machine to operate satisfactorily, and the consequent detrimental effect on the designer's reputation, often results from overlooking some seemingly unimportant factor. It is the writer's purpose to set forth in the following certain general points of design, which, if thoroughly considered, will help designers avoid mistakes of this kind.

Some of the most common factors responsible for the failure of machines to function properly are: Centrifugal force; vibration; gravity; friction; distortion; variation in product; expansion and contraction; and inaccessibility for repairs and adjustment.

The necessity for balancing high-speed rotating parts is well known. The centrifugal force of an unbalanced part will shorten the life of a machine and cause inaccuracies in the work produced. An example of this may be found in an unbalanced faceplate fixture of a lathe. The throwing out of lubricant, unlocking of latches and indexing-pins, and the throwing of loose parts away from the center of rotation are all troubles caused by centrifugal force. All rotating parts having a speed of more than 100 revolutions per minute should be carefully inspected for balance. Centrifugal force, however, can in some cases be used to advantage.

Factors that Cause Vibration

Vibration, which is injurious to all fine mechanisms, may be caused by unbalanced members, heavy reciprocating parts, or the sudden putting in motion of heavy mechanisms by the action of a cam or similar movements. The Geneva motion mechanism, if required to move a heavy load, will cause vibration. It sometimes happens that devices which are dependent upon springs for their action are unduly jarred just at the moment they are supposed to function, with the result that their efficiency is seriously impaired. On the other hand, vibration is sometimes employed for a useful purpose, as in the case of the jarring mechanism used in molding machines.

Failure of Gravity as a Usable Force

Gravity is often overestimated as a usable force, and ordinarily should be avoided as an unreliable means for operating a mechanism. The mere weight of an article is not always sufficient to carry it to the desired point, and often the direction taken by a falling member is entirely different from that counted on by the designer, owing to his failure to consider the position of the center of gravity.

In high-speed machines, gravity may not cause the part to move fast enough to keep up with the other moving parts. For instance, if the product is dropped from a hopper, the moving mechanism may pass the loading position before the part can drop into place. Such cases involve a difficult problem in timing, which should be avoided if possible. It is better to retain mechanical control over all moving parts than to depend upon gravity to bring any part into a given position.

Friction Must be Taken into Account

Every designer knows what friction is, and how to calculate the amount developed under given conditions, but its effect is overlooked in many cases and a much heavier load is placed upon some of the working parts than is intended. An example of this is found in the split nut employed on a feed-screw, which is supposed to open under the action of a spring when a predetermined tripping point is reached. However, at this point the load or end thrust against the feed-screw may be so great that the spring cannot force the nut open. If a heavier spring is used, it becomes impossible to engage it by hand. A drop worm or clutch mechanism is, therefore, preferable for such cases.

Another example is found in the case of a shaft that is required to slide endwise while subject to a turning motion. The friction on the key is sometimes so great that it cannot be overcome by the end-moving mechanism. Under such circumstances, the shaft may spring out of position or be broken. Bearings should be carefully proportioned and so designed that they will not cause excessive friction. Bearing surfaces are often so large that an enormous amount of oil is required for lubrication. In some cases, the bearing pressure is so great that a force-feed is required for the oil in order to obtain proper lubrication.

Friction drives are sometimes employed to prevent breakage, but care should be taken to see that slippage of the friction drive will not interfere with the synchronism of the mechanical movements. In some cases it is better to provide a shear pin to protect the mechanism against breakage due to

overloads. Friction clutches, when frequently engaged and disengaged, tend to become overheated and therefore wear out rapidly. Proper friction materials and lubrication will alleviate this trouble.

Frequently machine parts, although properly designed to withstand the load intended, are subjected to much heavier stresses than were anticipated, and the distortion, however slight, may injure the machine or interfere with the operation of the mechanism. The spring of a gap type punch press when punching heavy stock, for instance, is injurious to the dies and greatly shortens their life. Certain types of cradle or trunnion fixtures may become locked so that they cannot be rotated, as a result of the spreading of the cradle between the end bearings when the work-clamp is tightened. A careful analysis of the resulting forces set up by the clamping action, as well as the additional forces acting when the machine is in operation, is necessary to guard against troubles of this kind. After the stresses have been accurately determined, their effect can be counteracted by providing adequate bracing.

Expansion Caused by Heat

In machines that employ heat or are expected to operate under unusual temperature conditions, the expansion or contraction of the parts due to changes in temperature may be sufficient to prevent the functioning of the machine or some of its parts. All metals do not expand or contract alike with changes in temperature, and the amount of expansion or contraction is affected by the shape and position of the parts. Certain materials, often determined only by experiment, must be used to withstand the excessive heat to which they are subjected. The use of acid-resisting and non-corrosive substances must also be resorted to in some cases.

Avoiding Trouble Caused by Variations in Stock

Variations in the size and the shape of materials to be passed through a production machine is probably one of the greatest causes of trouble in the operation of automatic assembling devices. When it is impossible to so design a mechanism that it will make allowances for variations in the stock it is to handle, it is necessary to provide eliminators or selectors that will prevent stock from entering the machine which does not come within the specified limits.

It sometimes happens that, although a machine will operate successfully on one grade of material, it will fail to function satisfactorily on material purchased from another manufacturer or material of an inferior grade. This may result in discarding the machine, whereas a more rigid inspection of the material would be more economical than rebuilding the machine or designing an entirely new one.

Many designers apparently consider the general appearance of the machine of greater importance than accessibility for repairs. Some machines are so designed that the part or material is fed through a hole at one end and is not seen again until it mysteriously appears, completely finished, at the other end of the machine. While appearance should be considered, especially in the case of machinery built on the open market, accessibility of all its working parts is more to be desired. Accessibility or appearance, however, should not be allowed to influence the design to the detriment of production rates.

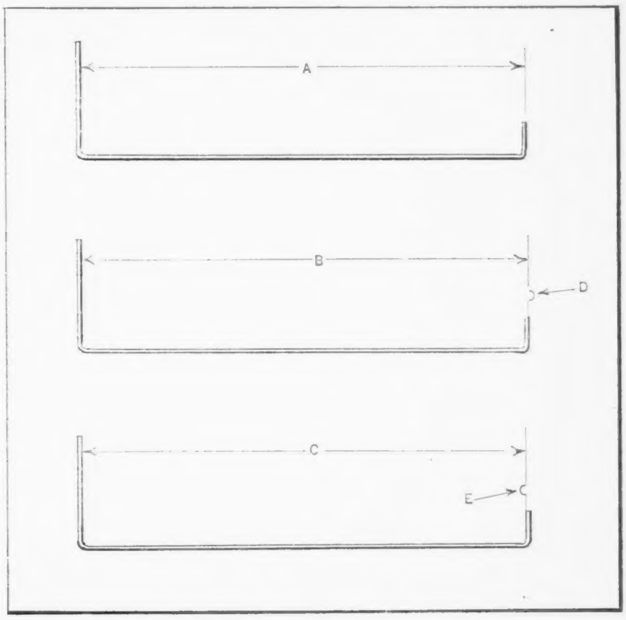
In general, it is suggested that positive mechanical actions are preferable at all times, although springs are useful for certain purposes. In using springs, however, care should be taken to allow sufficient time for them to operate. A good rule to follow is to have the material under positive mechanical control at all times. While we cannot expect to obtain perfection in the original design of a complicated mechanism, we should endeavor to select for each purpose the type of mechanism having the most positive action.

* * *

DIMENSIONING SHEET-METAL PARTS

By H. R. HAGEMAN

The writer has observed numerous methods for speeding up work on drawings during his thirty years of experience in shop and drafting-room. There is one fault, however, in the dimensioning



Methods of Dimensioning Sheet-metal Parts

of certain views of formed sheet-metal parts for which the writer has never seen a satisfactory remedy. This fault is found in the dimensioning of bent sheet-metal parts, as shown in the upper view of the accompanying illustration.

In such cases, the workman is often at a loss to know whether the dimension *A* terminates at the outside or the inside of the bent-up end. The original drawing might possibly be clear enough, but a slight inaccuracy in tracing may result in a blueprint with the dimension line positioned as shown in the illustration.

If the extension lines are drawn as shown at *B* and *C*, there can be no mistake. The convex line at *D* in the extension line can be quickly drawn free-hand, and indicates that the dimension extends to the outside of the part, whereas a concave line, as shown at *E*, shows definitely that the dimension is intended to extend only to the inner side of the bent portion.

Extrusion of Aluminum Collapsible Tubes

By ROBERT VALVERDE

IN the past, collapsible tubes, such as are used for tooth paste and similar substances, have been made from lead or tin. Both of these metals are soft and therefore lend themselves well to the manufacture of this type of container. Lead is relatively cheap, while tin is more expensive, but produces a much better looking tube. Hence, in spite of the great cost per pound of tin, tubes made from this material have been in considerable demand.

Efforts have been made to substitute a less expensive metal having the qualities of tin. Alloys of tin and lead have been used, but this resulted merely in what might be called a dilution of tin, with consequent loss of the properties most desired. About seven years ago, however, the improvements made in the purity and softness of aluminum encouraged serious efforts to make collapsible tubes from this metal.

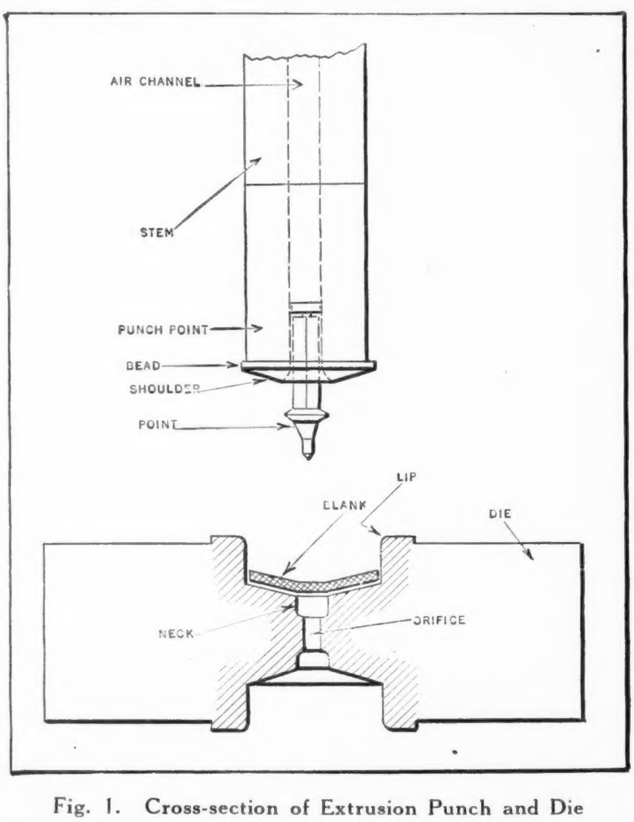


Fig. 1. Cross-section of Extrusion Punch and Die

Aluminum has many qualities that make it ideal for this purpose. It is light, fairly soft, quite ductile, tough, and lustrous. One of its objectionable qualities, however, is that after extrusion, it assumes a peculiar hardness and becomes brittle along the grain. This makes it a poor metal for collapsible tubes, because under frequent creasing, such a tube will crack and the contents leak. It is possible, however, by an annealing process, to restore the ductility of the metal and make the tube satisfactory for this purpose.

When aluminum tubes were first made, it seemed as if the difficulties met with in extruding this metal would make the manufacturing cost of the finished tube greater than that of tin, in spite of the fact that tin is a more expensive metal. The difficulties, however, were largely mechanical, and are now being successfully overcome by preparing the blanks properly, hardening the dies and punches, paying attention to their design, using automatic feeds, and in general, reducing the hand labor in manufacturing to a minimum.

Briefly described, the equipment for extruding aluminum collapsible tubes consists of a large power press of the toggle-gate type, a round polished steel punch, with a blunt end and a small projecting point so adjusted that it descends just enough to press tightly into a shallow polished cup made in a solidly bedded steel die, in which the punch fits loosely—that is, with clearance on the sides. Fig. 1 is a cross-section, showing the punch and die with a blank placed in the die.

Briefly, the operation is as follows: A flat blank is placed in the bottom of the die cup and the trip released. When the punch comes down, the metal is squeezed out through the small space between the punch and the die and literally squirts up around the punch, which is suddenly covered by a shiny tube. Then the punch is raised, bringing the tube with it. The neck and shoulder formed by the metal remain under the punch point. To get the tube off the punch automatically, a hole is drilled through the punch, so that compressed air can flow through it. The punch point is so designed as to seal the air hole during the extrusion process. When the punch swings free of the bed, a valve opens the air supply, and the sudden pressure blows the point forward, loosening the tube and blowing it off, clear of the machine.

From the extrusion machine, the tubes go to a trimming and threading machine. This consists of a gang of six mandrels mounted near the rim of a rotating chuck. The chuck rotates into six positions, and the mandrels rotate in one direction from the first to the fifth position. This permits the operator to slide the tubes off the mandrels in the sixth position. Then a trimmer moves up and trims off any projecting metal beyond the neck. The mandrel next moves under a wheel cutter, which trims the tube to the correct length. Then it advances under a fixture that rolls the thread on the neck. The mandrel then reverses and moves into the next position, where the tube is unscrewed and removed from the machine.

Next the tubes are placed in perforated tote boxes, the grease removed with kerosene, the tubes dried, and annealed. They then pass to the decorating department, where they are inspected, enameled, lithographed, the caps screwed on, and the tubes stacked upside down in boxes. In this con-

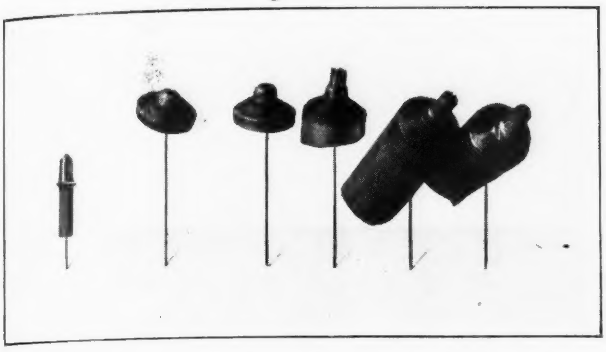


Fig. 2. Different Steps in the Extrusion Cycle, from the Blank to the Completely Extruded Tube. The Punch is Shown at the Left

dition, they are sold to the trade. After they have been filled, they are closed at the bottom.

As shown in Fig. 1, the end of the punch is provided with a detachable point. The punch is made in this way, because the strain on the point is great, and it often breaks off, requiring a new point to be substituted. The speed with which tubes can be extruded is about twenty-two a minute. It is important to avoid breakdowns as far as possible, and also to feed and strip the tube from the punch automatically, so that there will be no stoppage in the operation.

The substitution of an automatic feed and automatic stripping for manual operation materially reduces shutdowns due to defective blanks. When the operator does not need to feed the machine and take the tubes off the punch by hand, he can devote his time to inspecting and rejecting mutilated blanks, so that they will not pass into the machine. The danger from a bursting punch, which acts like shrapnel, is also removed when the automatic features are installed, because the working parts of the press can be readily screened without interrupting its operation, and, in addition, the press can be speeded up as much as 30 per cent, compared with hand operation.

As indicated in Fig. 1, the die is shaped to provide ample wearing surface and to act as a guide for the extruding tube, so that it will not tend to spread out, but will follow the punch. The rounded lips of the die serve a twofold purpose. They permit the blank to be readily placed in the die without canting, and they prevent scoring or mutilating the extruding metal. The punch has a peculiar bead around the edge. It is this bead that suffers wear and that controls to a great extent the quality of the finished tube. The slope of the shoulder and the shape of the floating point are also of great importance in permitting the metal to flow with the least pressure and to form a throat that will strip readily from the punch.

In Fig. 2 is shown an extrusion cycle from the blank to the completely extruded tube. The press was stopped at five positions in the cycle and the blanks photographed. Note the way the metal is pierced by the point without cracking at the neck or flowing unevenly. Also note the thin-walled throat closed at the end. The punch is shown at

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It is stated that there are now over one thousand laboratories in the United States engaged in engineering research work.

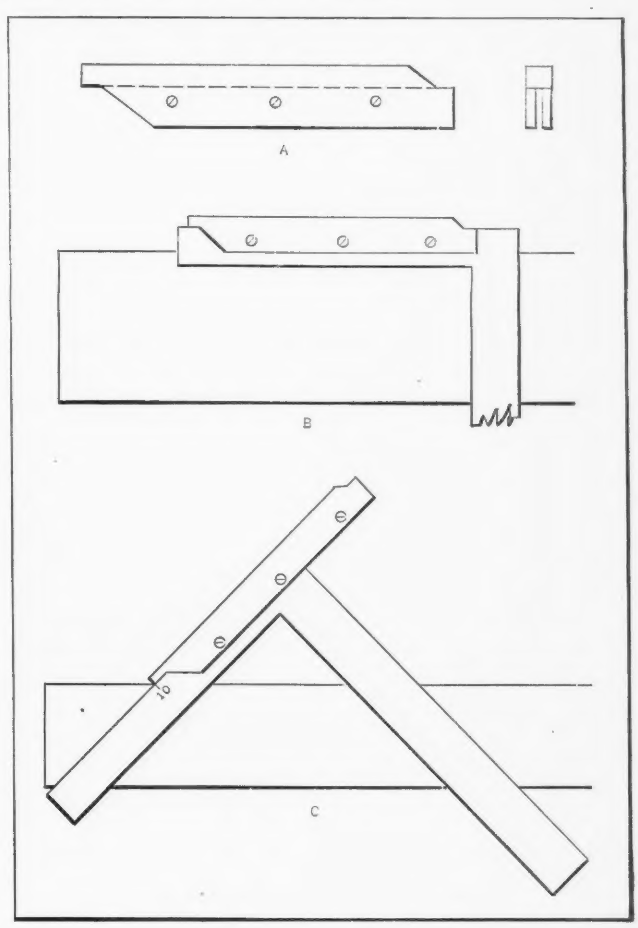
WOODWORKER'S SQUARE ALIGNER

By HERBERT A. FREEMAN

A bas-relief of ancient Egyptians at work shows that the square we now use differs little from the one used five thousand years ago. As two hands are required to hold the square accurately in position, it is extremely difficult for the workman to scribe a line or mark. The accompanying illustration shows at *B* a woodworker's square with an attachment that eliminates all tendency of the square to cock, tilt, or slide off the work.

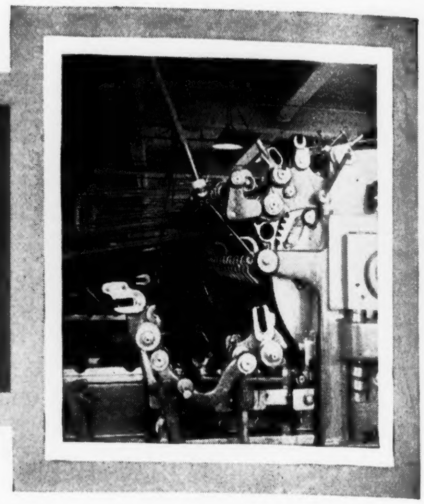
The square attachment or aligner *A* is made of hard wood, such as rock maple or hornbeam, grooved to fit snugly on the blade of the square. The depth of the groove is about 1/4 inch less than the width of the square. The ends of the aligner are notched to the depth of the groove. Ordinary wood screws, cut to a suitable length, are used to secure the aligner to the square.

When used to determine angles or bevels, the aligner is adjusted so that its outer extremity is at one of the graduations determining the bevel, as shown in view *C*. Without further attention to this end other than to hold the edge of the aligner against the work, the square can be moved until the other bevel determining graduation coincides with the same edge of the work. For example, if a 45-degree miter is to be scribed, as shown at *C*, the edge of the aligner is set at 10 inches, and this edge held against one edge of the work. The square is next moved until the 10-inch graduation on the other blade coincides with the same edge of the work. Then a line scribed along the edge of the blade will be at the desired angle.



Woodworker's Square with Aligner

Ingenious Mechanical Movements



MECHANISM TO OPERATE PRINTING WHEEL

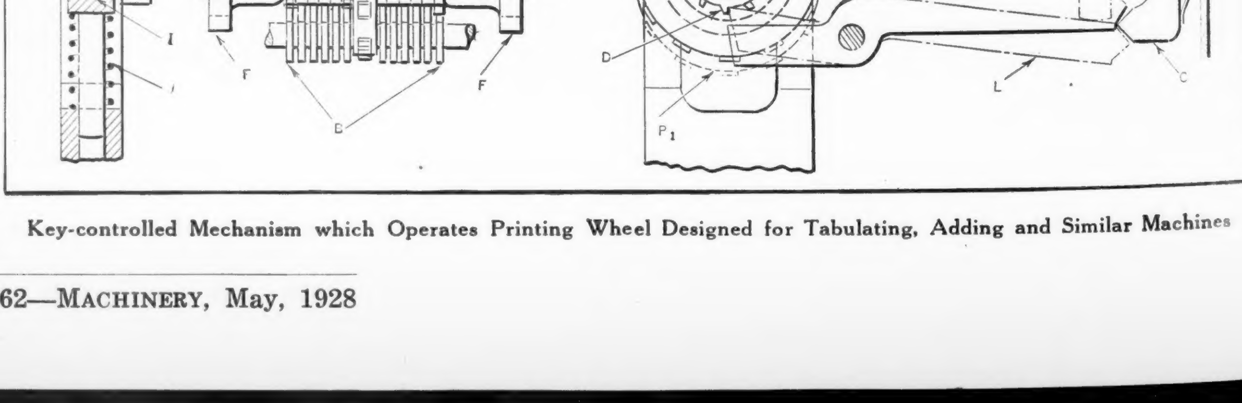
By PHILIP F. SHAFRAN

The mechanism represented by the accompanying drawing is for printing in tabulating machinery, adding machines, electric typewriters, stock quotation tickers, and in connection with similar apparatus. The illustration shows a diagrammatic cross-section of the inventors' model. This model consists of twelve keys *A*, twelve levers *B*, twelve spring pressed latches *C*, twelve single-toothed members *D*, two special toothed driving gears *E*, two driven gears *F*, one type-wheel *P*, containing figures 1 to 12, equally spaced, as shown, a driving shaft *G*, on which gears *E* are mounted, a driven shaft *H*, on which type-wheel *P*, parts *D* and driven gears *F* are mounted.

Two sliding bearings *I* support shaft *H* and hold driven gears *F* in mesh with the driving gears *E* by means of coil springs *J*. Shafts on bearings *I* slide in the reamed holes provided in two supports *K*. Supports *K* also provide fixed bearings for driving shaft *G*. The driven gears *F* contain the same number of teeth as there are figures in type-wheel *P*, and although it is not essential that driving gears *E* have the same number of teeth, it is preferable from a manufacturing point of view to have it so. In this model which is intended for use in conjunction with a perforating punch for tabulating work, the numbers 1 to 12 are used. For other work, such as adding machines, the figures 0 to 9 would be used, and the gears *F* would have ten teeth.

One set of gears *E* and *F* would be sufficient to work the mechanism, but two sets are used in this case for balancing and the better distribution of torque. The teeth on parts *D* and the centers of the teeth on gears *F* are so positioned that each one is centered radially to a figure on the type-wheel, and the twelve levers *B* are acted on by keys *A* corresponding to the numbers represented by the respective parts *D*.

The driving shaft *G* rotates continuously while the apparatus is in operation, obtaining its motion direct from a motor, and driving the driven shaft *H* through gears *E* and *F*. When a key *A* is depressed, it forces a lever *B* downward, as shown at *L*, and lever *B* is held in a downward position by the latch *C* while the key is returned to its original position by the light coil spring shown. The other end of the lever *B* is now in the path of the corresponding part *D* which is rotating with shaft *H*. When the tooth on part *D* comes in contact with the end of lever *B*, the shaft *H* and the parts keyed to it are prevented from turning and by the action of the special circular teeth on gears *E* and *F* are forced down to the position indicated by P_1. The number corresponding to the key pressed is then printed. Part *D* in coming down restores lever *B* to its original position and when spring *J* returns shaft *H* to its original position, shaft *H* is free to turn until interrupted by the depressing of another key.



Key-controlled Mechanism which Operates Printing Wheel Designed for Tabulating, Adding and Similar Machines

Should the lever B strike on top of the tooth on part D as it rotates, the latch C will have passed the point on the cam on the end of B and by the action of the spring pressing against latch C, the stroke of B would be completed when the tooth on part D cleared the lever B.

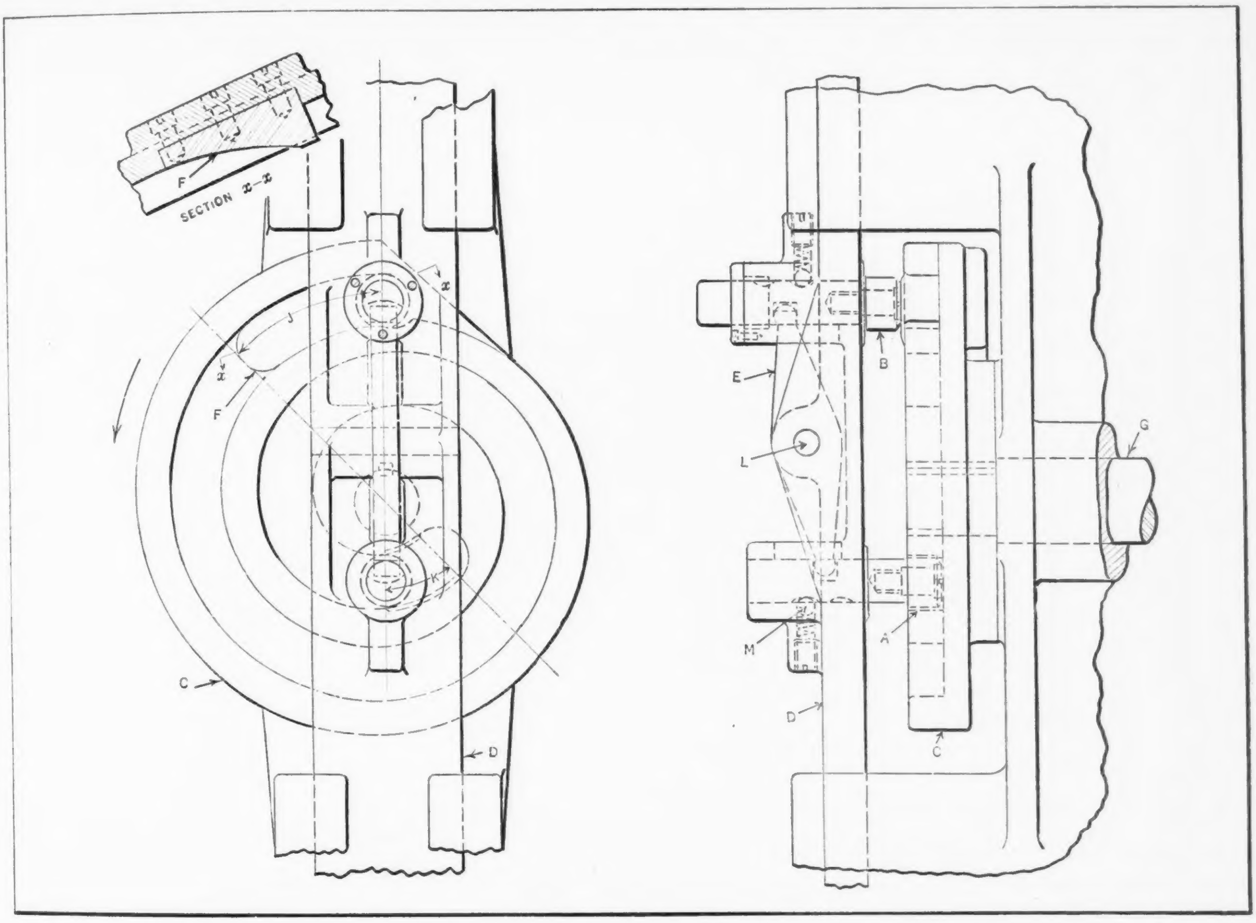
* * *

SPIRAL CAM FOR RECIPROCATING MOTION

By J. E. FENNO

A positive spiral cam drive for imparting a reciprocating motion to a slide is shown by the illustration. The cam C, which has a spiral groove, revolves continuously in the direction indicated by the arrow, and transmits motion to slide D through engaging rollers A and B which are connected by rocker arm E, and are arranged to engage the cam alternately. If roller A is in the inner position or at the inner end of the cam groove as shown, it will be traversed to the outer end of the groove while the cam makes 1 1/2 revolutions; as this roller approaches the outer end of the groove, it engages a cam insert F (see also detail sectional view) placed in the groove; consequently, roller A rides up the inclined surface of this cam insert, which causes rocker E to force the other roller B down into engagement with the inner part of the cam groove; then the return stroke of the slide begins as the cam continues to revolve, and when roller B has reached the outer position, thus completing one cycle, the action is reversed, roller A being again forced into engagement at the inner position of the cam groove. It will be seen then that three cam revolutions are required for the forward and return strokes of the slide, and the rollers successively traverse from the inner to the outer positions.

At the beginning and end of the spiral, the groove is milled concentric with driving shaft G (as indicated by the arrows J and K) which provides a dwell equivalent to one-eighth revolution of the cam at each end of the stroke. The concentric sections J and K also permit the rolls to enter and leave the groove freely. The spiral groove advances uniformly so that a uniform motion is imparted to the driven slide. The rocker E, which swings on pin L, has rounded ends that engage grooves cut in the roller plungers. Pawl M which is backed up by a spring, drops into either of two half round grooves in the plunger for locating it in the upper and lower positions. The other plunger has the same arrangement. The cam insert F is of hardened tool steel and the rolls are beveled at the bottoms to correspond with the curve of the insert.



Spiral Cam which is Engaged Alternately by Two Rollers on Rocker Arm of Driven Slide

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AUTOMATIC INDEXING AND SPACING MECHANISM

By F. C. MASON

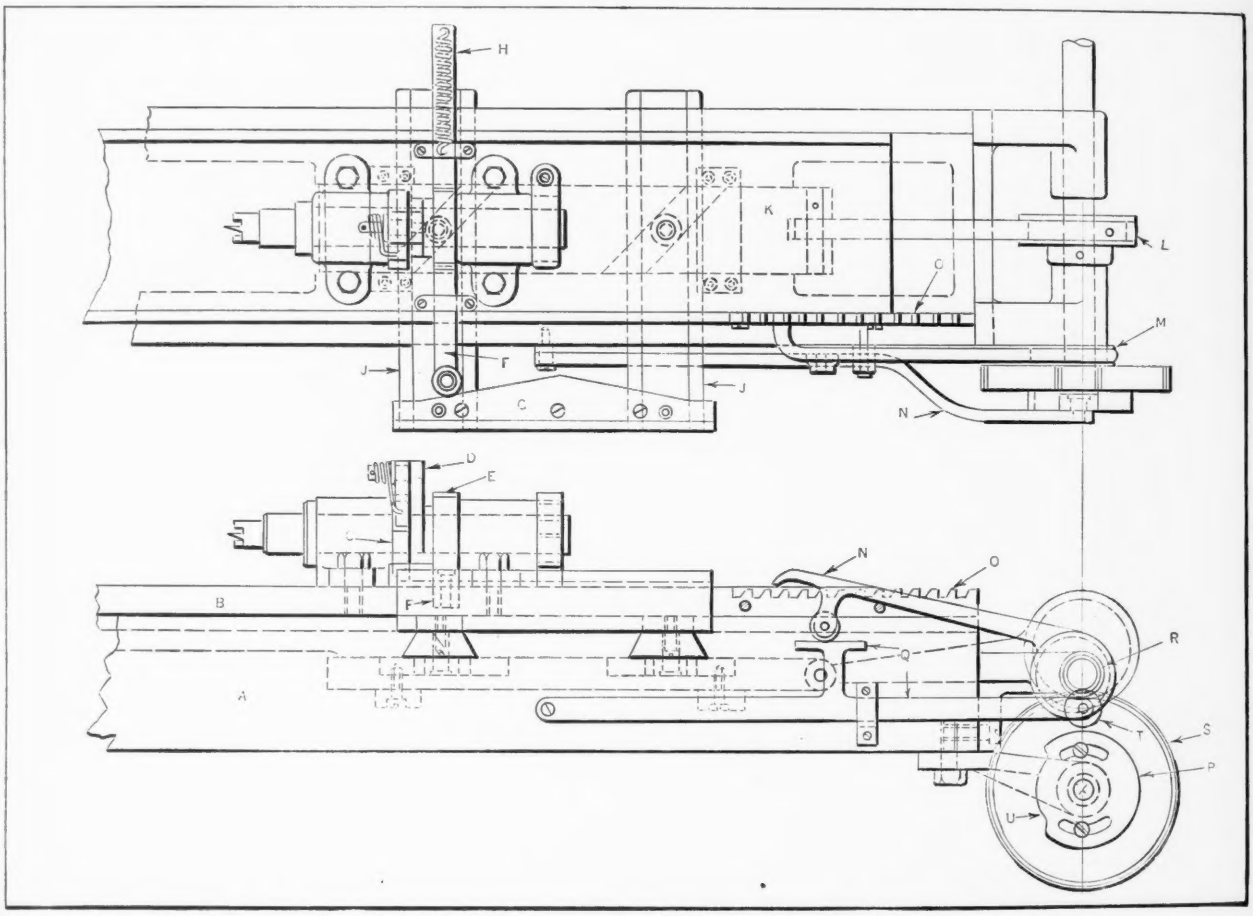
The arrangement of a very successful indexing and spacing mechanism, which is part of a semi-automatic machine for drilling rows of bristle holes in carpet-sweeper brush rolls, is shown by the front and plan views in the accompanying illustration. Although this mechanism is used on a wood-working machine, the principle could doubtless be applied to metal-working or other machines.

In each brush roll there are five equally spaced twenty-four-hole rows which, instead of being straight or parallel to the axis, lie along a double helical curve to locate the bristles in wave formation. The drilling of 120 holes in each brush roll is done at the rate of 120 rolls per hour, and as two drills are used, the longitudinal spacing and indexing is at the rate of 7200 times per hour. The novel features of this mechanism are the methods of indexing the work and automatically producing a helix which changes from right to left along the roll length to provide rows with a double wave.

The table housing *A* supports the index carriage *B*, which has a headstock and also a tailstock (the latter is not shown). The main spindle of the headstock has a five-tooth indexing ratchet *C*. The pawl engaging this ratchet is held in contact with it by a spring and is pivoted to lever *D*, which is integral with gear *E*. This gear meshes with a cross-rack *F* having a roll at one end, which is held in contact with cam *G* by spring *H*. Cam *G*, which slopes in opposite directions, produces the double helix referred to and it connects with the cross-slides *J*. Rollers on these cross-slides engage 45-degree cam grooves in the longitudinal slide *K*, which is given a reciprocating movement by eccentric *L*. The longitudinal spacing or carriage movement is obtained by eccentric *M* (plan view), operating pawl lever *N* which engages rack *O* attached to carriage *B*. The time of this spacing movement is regulated by cam *P* and cam-lever *Q*. Cam *P* is rotated by the timing gears *R* and *S*.

The cycle of operations is as follows: The two 45-degree cross-slots in cam-slide *K* transmit the stroke of this slide to cross-slides *J* and cam *G*. This movement is also transmitted to rack *F*, gear *E*, pawl-lever *D* and the pawl, thus indexing the headstock spindle. If cam *G* were straight, instead of being angular, no helix would be obtained, but as carriage *B* is indexed along by the rack and pawl *O* and *N*, the lateral position of *F* is continually changing, so that the indexing movement successively occurs either earlier or later, depending upon whether the roll of rack *F* is ascending or descending the cam slope.

The two drills are so located that one drills all the holes from the end to the middle of the roll, and the other drills the holes from the middle to the opposite end. After each drill has drilled five holes around the circumference, the carriage is moved forward by the engagement of pawl *N* with rack *O*. The ratio of pinion *R* and gear *S* is necessarily 5 to 1. The function of cam *P* is to drop lever *N* into contact with feed-rack *O* after each revolution of pinion *R*. The roll of lever *N* rides on the T-shaped section of lever *Q*, and *N* is held out of engagement with *O* until roll *T* reaches drop *U* on the cam.



Front and Plan Views of Automatic Indexing and Spacing Mechanism

As this machine is for a definite purpose, it is made for indexing five divisions only, but modifications would permit varying the number of divisions or length of spacing, as well as the curvature of the rows of holes. To make the mechanism more universal, it would be necessary to have change-gears at *R* and *S* and adjustable cranks in place of eccentrics *L* and *M*. Fine tooth ratchets at *C* and *O* also would be required. This mechanism has been operating 8 1/2 hours daily for four years, and has never required repairs.

MACHINERY'S DATA SHEETS 129 and 130

TENTATIVE AMERICAN STANDARD NUTS—3

FINISHED AND SEMI-FINISHED HEXAGONAL JAM NUTS

Diameter of Bolt (All dimensions in inches)	Width Across Flats		Width Across Corners	Thickness		
	Maximum	Minimum	Minimum	Nominal	Maximum	Minimum
1/4 0.2500	7/16 0.4375	0.428	0.488	5/32	0.163	0.150
5/16 0.3125	9/16 0.5625	0.552	0.629	3/16	0.195	0.180
3/8 0.3750	5/8 0.6250	0.613	0.699	7/32	0.227	0.211
7/16 0.4375	3/4 0.7500	0.737	0.840	1/4	0.259	0.241
1/2 0.5000	13/16 0.8125	0.799	0.911	5/16	0.323	0.303
9/16 0.5625	7/8 0.8750	0.861	0.980	11/32	0.355	0.333
5/8 0.6250	15/16 0.9375	0.922	1.051	3/8	0.387	0.363
3/4 0.7500	1 1/8 1.1250	1.108	1.263	7/16	0.451	0.424
7/8 0.8750	1 5/16 1.3125	1.293	1.474	1/2	0.516	0.484
1 1.0000	1 1/2 1.5000	1.479	1.686	9/16	0.580	0.545
1 1/8 1.1250	1 11/16 1.6875	1.665	1.898	5/8	0.644	0.606
1 1/4 1.2500	1 7/8 1.8750	1.850	2.109	3/4	0.771	0.729
1 1/2 1.5000	2 1/4 2.2500	2.222	2.533	7/8	0.900	0.850
1 3/4 1.7500	2 5/8 2.6250	2.593	2.956	1	1.029	0.971
2 2.0000	3 3.0000	2.964	3.379	1 1/8	1.158	1.093
2 1/4 2.2500	3 3/8 3.3750	3.335	3.802	1 1/4	1.286	1.214
2 1/2 2.5000	3 3/4 3.7500	3.707	4.226	1 1/2	1.540	1.460
2 3/4 2.7500	4 1/8 4.1250	4.078	4.649	1 5/8	1.669	1.581
3 3.0000	4 1/2 4.5000	4.449	5.072	1 3/4	1.798	1.703

Formulas

Width across flats of jam nuts shall be 1 1/2D (D = diameter of bolt) except as follows:

Diameter of Bolt	Width Across Flats
1/4 to 9/16	1 1/2D + 1/16

with adjustments in the sixteenth inch sizes to eliminate thirty-second inch size wrench openings.

Tolerance for width across flats shall be minus ($0.015D + 0.006$).

Minimum width across rounded corners of hexagon equals 1.14 times minimum width across flats.

Thickness of jam nuts, sizes 1/4 to 7/16 inch, shall be $1/2D + 1/32$; for sizes 1/2 to 1 1/8 inches, $1/2D + 1/16$; for sizes 1 1/4 to 2 1/4 inches, $1/2D$ + 1/8; 2 1/2 to 3 inches, $1/2D + 1/4$.

Tolerance for thickness shall be $0.030D + 0.005$.

The finished top, or both top and bottom, of jam nuts shall be flat and chamfered; angle of chamfer with surface shall be 30 degrees; diameter of top, or of both top and bottom circles, shall be 100 per cent of the nominal width across flats.

Tolerance on diameter of top flat circle shall be minus 15 per cent.

For jam nuts with a washer face, the thickness of the washer face shall be 1/64 inch. The thickness of the nut shall be the distance from the top of the nut to the bearing surface. The bearing surface of washer face shall be 100 per cent of the nominal width across flats. Tolerance on the diameter of the washer face shall be plus or minus 5 per cent.

The axis of the threaded hole shall be at right angles to the washer face within a tolerance of 2 degrees.

MACHINERY'S Data Sheet No. 129, New Series, May, 1928

TENTATIVE AMERICAN STANDARD NUTS—4

HEXAGONAL LIGHT NUTS

Diameter of Bolt	Width Across Flats		Minimum Width Across Corners	Thickness		
	Maximum	Minimum		Nominal	Maximum	Minimum
1/4 0.2500	7/16 0.4375	0.428	0.488	7/32	0.225	0.212
5/16 0.3125	1/2 0.5000	0.489	0.557	17/64	0.273	0.259
3/8 0.3750	9/16 0.5625	0.551	0.628	21/64	0.336	0.320
7/16 0.4375	5/8 0.6250	0.612	0.698	3/8	0.384	0.366
1/2 0.5000	3/4 0.7500	0.737	0.840	7/16	0.448	0.428

All dimensions given in inches.

Note: Light nuts are recommended for use with fine threads only.

If D = diameter of bolt, then thickness of light nuts shall be 7/8D (to nearest 64th lower for 1/4 and 7/16 inch sizes).

Tolerance for width across flats shall be minus ($0.015D + 0.006$).

Minimum width across corners of hexagon equals 1.14 times minimum width across flats.

Tolerance for thickness shall be $0.030D + 0.005$.

HEXAGONAL AND SQUARE MACHINE SCREW NUTS AND STOVE BOLT NUTS

Diameter of Screw	Width Across Flats		Width Across Corners	Thickness		
	Maximum	Minimum	Minimum	Nominal	Maximum	Minimum
No. 0 0.0600	5/32 0.1562	0.150	0.171	3/64	0.050	0.043
No. 1 0.0730	5/32 0.1562	0.150	0.171	3/64	0.050	0.043
No. 2 0.0860	3/16 0.1875	0.180	0.205	1/16	0.066	0.057
No. 3 0.0990	3/16 0.1875	0.180	0.205	1/16	0.066	0.057
No. 4 0.1120	1/4 0.2500	0.241	0.275	3/32	0.098	0.087
No. 5 0.1250	5/16 0.3125	0.302	0.344	7/64	0.114	0.102
No. 6 0.1380	5/16 0.3125	0.302	0.344	7/64	0.114	0.102
No. 8 0.1640	11/32 0.3437	0.332	0.378	1/8	0.130	0.117
No. 10 0.1900	3/8 0.3750	0.362	0.413	1/8	0.130	0.117
No. 12 0.2160	7/16 0.4375	0.423	0.482	5/32	0.161	0.148
1/4 0.2500	7/16 0.4375	0.423	0.482	3/16	0.193	0.178
5/16 0.3125	9/16 0.5625	0.545	0.621	7/32	0.225	0.208
3/8 0.3750	5/8 0.6250	0.607	0.692	1/4	0.257	0.239

All dimensions given in inches.

Width across flats of machine screw and stove bolt nuts shall be as follows (D = diameter of bolt):

Diameter of Screw	Width Across Flats
1/4 to 1/2	1 1/2D + 1/16

with adjustments in the sixteenth sizes to eliminate thirty-second inch size wrench openings.

Minimum width across rounded corners of hexagon equals 1.14 times minimum width across flats.

Minimum width across rounded corners of square equals 1.373 times minimum width across flats.

MACHINERY'S Data Sheet No. 130, New Series, May, 1928

Notes and Comment on Engineering Topics

Of the ships launched in 1927 in Great Britain and Ireland, a tonnage equivalent to 137,600 was provided with steam turbines and 355,800 tons with oil engines. The largest oil-engine ship during the year was a vessel of 16,000 tons. The oil-engine ships represented 41 per cent of the steam engine tonnage launched. The total tonnage launched was 1,226,000. The total tonnage of oil-engine-driven ships at the present time is 4,271,000.

A new welded steel-frame factory building is being erected by the General Electric Co. at its new Philadelphia plant. The structure is approximately 140 feet wide, 600 feet long, and 50 feet high. The main wing of the building has a crane-bay over which are located twenty welded trusses each having a span of 58 feet. There is also a gallery in an adjacent wing over which there are twenty welded trusses, each of about 80-foot span.

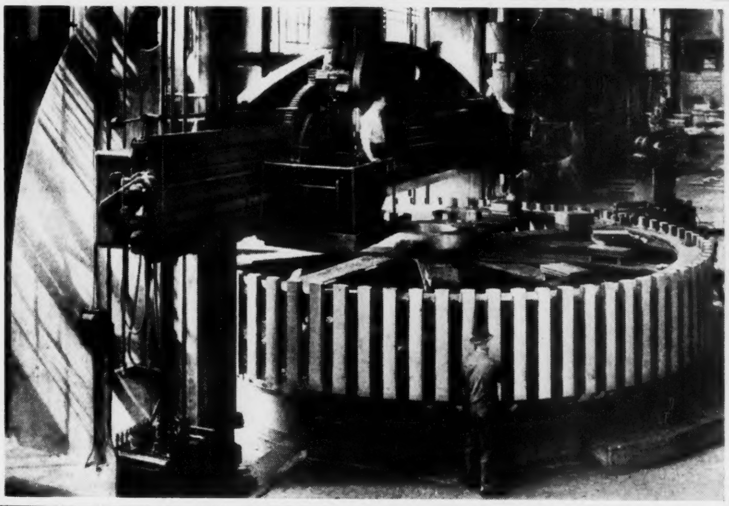
What are said to be the five heaviest and most powerful fast passenger engines ever built have recently been completed by the American Locomotive Co. for the Delaware, Lackawanna & Western Railroad. The engines are known as the "Pocono" type. They are 97 feet in length, and the eight driving wheels are 77 inches in diameter. A four-wheel pilot truck and a four-wheel trailing truck complete the wheel arrangement. Each engine weighs 421,000 pounds, and has a maximum tractive power of 64,500 pounds.

Standard specifications for malleable iron castings have just been published by the British Engineering Standards Association. The standards are contained in publications Nos. 309 and 310, copies of which may be obtained from the British Engineering Standards Association, Publications Department, 28 Victoria St., London, S.W. 1, England. The price is 2/2. The principal clauses in the specifications cover the mechanical and machining properties of the castings. No chemical composition is specified, as it is considered that the mechanical properties should be regarded as the main requirements. The chemical composition is merely an auxiliary check upon the suitability of the material to perform the duties required.

Owing to the great number of ships sunk during the World War, it has frequently been stated that it would take many years to build up a merchant marine of the same tonnage as that in service previous to the war. Subsequent events have proved this view to be entirely erroneous. On the contrary, it took but a few years to equal the pre-war tonnage, and at present the tonnage of sea-going steam- and oil-engine-driven ships is 40 per cent greater than in 1914. It has risen from 42,500,000 tons before the war to nearly 60,000,000 tons at the present time.

MACHINING A 29-FOOT CASTING

The accompanying illustration shows the machining of a large cast-steel spider weighing 175,000 pounds and measuring 29 feet in diameter. The work is performed at the South Philadelphia Works of the Westinghouse Electric & Mfg. Co. The spider is part of the rotating element of a 40,000 KVA generator which is said to be larger in diameter than any other ever built, being 37 feet over all. This shows the constant increase in size of electrical machines.



Machining a Cast-steel Spider Weighing 175,000 Pounds and Measuring 29 Feet in Diameter

A large flying machine has been used in Germany for advertising in the sky at night by means of electric signs attached to the under side of the wings. The plane used was originally built for carrying fourteen passengers and had a combined wing spread of 92 feet. To the wings were securely fastened electric signs displaying text that could be plainly read from below when the machine circled at a height of about 2000 feet. The plane was provided with a gasoline-engine-driven generator, producing the current required. The lighting equipment weighed approximately 1650 pounds. The results are said to have been so satisfactory that plans have been made for similar electric sign advertising over many of the larger German cities.

It is estimated that about 63 per cent of American homes today are supplied with electric current. There are over 4400 electrical power stations supplying current to consumers. The gross revenue in 1927 was $1,783,000,000 and in the same year $2,100,000,000 was raised in new capital for the extension of electric power plants.

Current Editorial Comment

In the Machine-building and Kindred Industries

HOOVER AND THE INDUSTRIES

Herbert Hoover, during his seven years as Secretary of the Department of Commerce, has always recognized that the compilation of accurate statistical data is essential to the progress and welfare of every business and industry. He has brought about in this respect a new attitude on the part of the Government toward trade associations, the activities of which were formerly regarded by many government officials as detrimental to the public welfare. Mr. Hoover probably has done more than any other man to show that trade associations are absolutely essential to stabilized business conditions, and therefore to security of employment and general prosperity. He has given personal encouragement, through his department, to all legitimate trade association work.

As a result, there is now available far more accurate information about business conditions than ever before, and manufacturers are now able to plan for the future in ways they never have been able to do in the past. Their plans are based to a much larger extent on facts and less on guesses than formerly. This, in turn, has helped to prevent booms and extreme depressions—a change as welcome to the industries as to the people of the country.

* * *

PORTABLE TOOL SAVINGS

Great changes in shop methods have resulted during recent years from the ever increasing use of portable tools. The facility with which such tools may be brought to the work, instead of bringing the work to a machine, and the consequent saving in time and cost, have made the portable tool an essential part of up-to-date shop equipment.

The word "portable" as applied to machine shop tools does not always imply that the tool can be picked up by hand and carried around the shop. It rather means that it is possible to transport an appliance from one place to another in the shop by the usual shop facilities for moving material about the plant, such as trucks, hoists or cranes; so that the expression "portable tools" is used to mean "movable tools" to distinguish them from machines that are set on a foundation or fixed to the floor and remain in that position when in use.

Portable tools are now made in both very small and very large sizes. The smallest electric drills are used by dentists, jewelers and instrument makers, one of the latter having a maximum capacity for holes 1/32 inch in diameter and being provided with a motor developing less than 1/10 horsepower. The entire tool weighs less than a pound. Among the very large sizes are tools capable of drilling 1 1/2-inch holes in steel.

The saving of time effected by employing portable tools insures their increasing application in many plants and repair shops where they are not yet used to as great an extent as their convenience warrants.

A New Selling Policy

Machine tool manufacturers and dealers at present are considering a change in selling terms whereby used machine tools will no longer be taken in part payment for new tools. If this policy is adopted by all dealers in new machinery, used machines will be handled only by dealers that specialize in such equipment. Manufacturers and dealers have long realized the difficulty of selling both new and used machines, and the practice of taking old machines in trade has always been unsatisfactory and should be eliminated. It is surely better for both manufacturers and dealers that the purchase of a new machine be based entirely on its merits rather than upon the allowance the dealer can make for an old tool. Many of the larger manufacturers and several dealers have expressed themselves as favoring the proposed change, believing that both the maker and distributor would be benefitted.

* * *

X-RAYS IN THE MACHINE SHOP

When Professor Rœntgen announced, thirty-three years ago, that he had discovered a light ray which would penetrate solid objects and made it possible to see through solid sheets of metal, his discovery was regarded as of great interest to scientists, but of little value for everyday practical purposes. Later, medical science found the application of X-rays of extreme value, but only within the last few years have engineers been able to make practical use of this remarkable discovery in ordinary shop work. Now the X-ray camera is used for the inspection of castings and forgings in several industrial plants.

An X-ray photograph of a casting will show whether there are cold shuts or other defects in the casting which are not visible on the surface. The soundness of castings subjected to hydraulic pressure, for example, is extremely important, and the X-ray is the only means by which the interior of the casting may be examined without breaking it. Forgings and boiler plate may be similarly inspected for internal defects.

The leading article in this number of MACHINERY, "X-Ray Inspection in the Machine Shop," describes comprehensively the purposes for which X-ray photographs may be used. Photographs that show interior defects in castings, forgings and plates are shown in this article, and the equipment required is described. The mechanical industries have found in the X-ray a new inspection device, the application of which will increase in years to come.

The cost of an X-ray installation is not prohibitive. The necessary equipment, ready for use, would range in cost from about $1000 to $7500, according to the kind of material to be inspected. Some installations have paid for themselves in a year.

Selecting and Developing Men in Industry

By WALTER C. WHITE, President, White Motor Co., Cleveland, Ohio

THE question has been asked: "Is there any well defined method by which the executives and personnel of the White Motor Co. are selected? The character of the organization and the length of time that both executives and shop men remain with the organization make it reasonable to assume that the men have been selected by careful methods in the first place, and given an opportunity to develop their abilities to the best interests of both themselves and the company in the second."

To answer this question briefly is not an easy matter. It is true that careful methods are used by our company in both selecting and developing men for the work they are to undertake, but there is no simple formula that can be stated as generally applicable to all conditions.

However, this basic principle may be laid down at the outset. Every manufacturer takes the greatest care in selecting the machinery and equipment for his shop and in choosing the materials to be used in building his product. Generally, the same amount of time and care is not taken in selecting the men that are to make the machinery and equipment function in an efficient manner. This is where the management of many industrial undertakings fails to obtain the greatest possible returns on the investment in its plant. Perhaps the reason is that a machine, once bought, stays in the shop and cannot be discharged, whereas if a man is a misfit, it seems an easy matter simply to fire him; but that is not good management, nor does anybody need what we term "executive qualifications" to manage a plant in that manner. Anyone can fire a man, but it takes a good deal of judgment and conscientious care to hire the right man for the work for which he is intended; and it takes a still abler man to take an inefficient or misfit man and train him so that he will become a useful employe in the kind of work for which he may be best fitted.

Walter C. White, President, White Motor Co.

This should not be taken to mean, however, that if a mistake is made in selecting a man he should be kept in a position for which he is not suited. In hiring or selecting men, especially for executive positions, anyone may at times make a mistake; but it is a still greater mistake to keep him in such a position after it has become evident that he is not capable of filling it. To do so is an injustice not only to the man himself, who may be able to make progress along some other line of endeavor, but also to the company and to his fellow workers, whose progress will be hampered by an inefficient man. The executive who selects men must have the courage to acknowledge his mistakes in his choice whenever it becomes evident to him that he has made a mistake.

The Young Man's Place in Modern Industry

I believe in young men and in young executives. Most of the men in responsible positions at the White Motor Co. are men under fifty years of age—some very much younger. In making this statement, I do not underestimate the value of experience, but it takes a great deal of mere experience to make up for the enthusiasm, energy, enterprise, and vision of younger men. The young mind is forward-looking and is ready to try new methods and means for accomplishing results. It is not hedged in by habit and precedent. The young mind is also quicker to accept suggestions and is less likely to believe that it has nothing to learn; hence it is more adaptable.

When we have a place to fill, therefore, we believe in filling it from the ranks of the men who have grown up with the organization. With the view of having a constant supply of men capable of filling positions that become open from time to time, we are annually taking in a number of young college men and are training them to meet our future need for executives in various departments. Our experience indicates the great value of constantly bringing new men into the organization, but we believe in taking young men and training them, rather than in hiring full-fledged executives from the outside. Only when we cannot find the right

men within our own organization do we go outside, and in that case we blame ourselves more than the men already with us for the necessity of having to look elsewhere; because we realize that we should have developed some man or men for just the position to be filled, and should not have left it to chance to find a properly equipped man trained elsewhere.

Hence, each year we take in about a dozen college men, very carefully selected, and give them a training period of from twelve to eighteen months. Our aim also is to start enough young men and boys each year in the shop as regular apprentices, about half of these being high-school graduates and about half, grammar-school boys. In this way, we are training men of various degrees of preliminary education, capable of filling all executive or semi-executive positions in the shop, the sales organization, and the general management. We do not take in a great number of either class of young men for training, as our aim is to train only enough to take care of our needs with a view to providing an opportunity for advancement to every young man that has come with our company and has proved capable of progressing with our business.

The Qualities that We Look for in Men for Our Organization

In selecting college graduates, a great deal of care is exercised. The selection depends upon the combined judgment of three executives who, in the spring of each year, visit a number of colleges and universities to interview young men who have been especially recommended by the college authorities as suitable for our work. Each of these three men interviews the applicant separately and forms his own judgment. Generally one executive in this committee is from the sales department, one from the service department, and one from the production end of the plant.

In addition to the scholarship record, the selection is based on the personality, initiative, and leadership of the young man. The two latter qualifications can generally be well judged by noting the college activities in which he has taken part. Character and promise of ability to progress and develop for important work in our field are the most important factors in the final selection of the men chosen.

Methods of Training Men for Sales and Executive Positions

When the young men selected come to the White Motor Co.'s plant, they are first trained in the shop for a period of about six months, spending a comparatively short time in each department. Those showing inclination for sales work are then detailed for service at the different district offices of the company, and if they make good on this work, they generally remain with the district office indefinitely.

In the training of these men, the basic principle is that one learns most by doing. In our line of work we also believe that during a comparatively short training period a young man can learn more by inspecting the product than by any other method. He is, therefore, started on the inspection of the materials and tools that come into the receiving department. Then he moves from department to department as process inspector, until he reaches the final inspection and testing departments. If he shows particular inclination for shop work, he is gradually promoted to a shop executive position instead of being transferred to the sales department.

The regular apprentices are trained more directly in shop work. No exact length of time is laid down for the apprentice course, because a young man who shows unusual ability in performing the work given to him has an opportunity to progress faster than he otherwise would, thereby shortening his course.

The results of this method of training have been unusually satisfactory. Fully 70 per cent of those trained in our shops and offices have remained with us for a period of five years or longer. As a matter of fact, the White organization is proud of its record in keeping men. Over 40 per cent of all the employes of the organization have been with the company for more than five years. Over fifty men have participated in and contributed to the White Motor Co.'s progress for more than twenty years, and several men have been with the company ever since it began operations in the automotive field.

> I believe in young men and in young executives. Most of the men in responsible positions at the White Motor Co. are men under fifty years of age—some very much younger. Experience is valuable, but it takes a great deal of mere experience to make up for the enthusiasm, energy, enterprise, and vision of younger men. The young mind is forward-looking and is ready to try new methods and means for accomplishing results. It is not hedged in by habit and precedent. The young mind is also quicker to accept suggestions and is less likely to believe that it has nothing to learn; hence it is more adaptable.—Walter C. White

How Men are Selected for Promotion

In general, I presume that every executive selects a man for promotion by the way in which he handles the job he is holding, but in many cases the man's ability in his job is judged rather by a personal opinion than by actual records of his efficiency, sales, production, and other accomplishments. In our company, when an occasion for promotion arises, we have a small informal committee that expresses its opinions and passes judgment before a man is selected for the job to be filled. Other things being equal, we choose the human kind of man—the man of personality and human qualities. I presume that is why people say that there is a human spirit and atmosphere throughout our organization.

Now, what do I mean by human qualities? If a man's success is to be lasting, it must be built on a foundation of service—to the company, to his fellow workers, and to the public. The more selfish and narrow the viewpoint of a man is, the more likely he is to go off on a wrong tack if an important decision is to be made. If he looks at things from a broad social and economic point of view, his success is much more likely to be lasting, and his value to the company is, therefore, that much greater. This is a point of considerable importance that is often overlooked in the selection of men.

The Value of Hard Work in Developing an Executive

No man can develop his latent abilities and become permanently successful in business without assuming responsibility and faithfully discharging it. To build a solid foundation for his life work, the young man to be promoted must have shown that he is a worker. The secret of satisfaction in having is in the getting. The man who gets things without work does not appreciate and value properly either his own or the company's interests, and he is not nearly so likely to hold on to what he has obtained. If success is to be lasting, it has to be won through work and not merely accepted as a gift.

I also believe that the more training a man can get the better, if his success is to be permanent, and no one can obtain a thorough training without hard work. I believe further that true merit does not remain undiscovered. I believe that in most instances the outstanding man gets the job for which he has the qualifications and has proved his fitness.

Taking Advantage of the Originality of Men

In every organization there are some men who differ in their general characteristics from the average type. They are men whose chief assets are originality, force, and the ability to get results. These men often have very decided opinions as to how they can achieve the best results, and frequently they are considered somewhat difficult to get along with. However, we judge these men by their results and achievements and feel that, within the limits of the policies of the organization, it is reasonable for the organization to adjust itself to their personality. We believe that resourcefulness and originality are great assets and should not be discouraged, and we feel that a man should be judged by his results and not by the methods that he may develop for achieving the results.

In hiring men, I believe in weighing their records long and well, and when once selected, in giving them a chance to use their own judgment, so that they may develop to as great a degree as their ability will permit. Other things being equal, we choose the human kind of man—the man of personality and human qualities. Now, what do I mean by human qualities? If a man's success is to be lasting, it must be built on a foundation of service to the company, to his fellow workers, and to the public. The more selfish and narrow the viewpoint of a man is, the more likely he is to go off on a wrong tack if an important decision is to be made.—Walter C. White

Principles on Which the White Motor Co.'s Methods of Selecting Men are Based

Briefly, in hiring men, I believe in weighing their records long and well, and when once selected, in giving them a chance to use their own judgment, so that they may develop to as great a degree as their ability will permit. I believe in achieving through personal effort, and in selecting the man who promises to have a lasting rather than a temporary success. I believe in men whose aims in life are something more than mere position, salary, and individual achievement. There is a kind of unselfish personal achievement that carries with it personal reward, but the achievement is undertaken for its own sake, and not for the sake of the reward. The men that most nearly measure up to this kind of achievement are those who reap the greatest benefits for themselves, the company, and the community.

HOIST MANUFACTURERS' MEETING

The eleventh annual meeting of the Electric Hoist Manufacturers' Association was held in New York City March 15. N. A. Hall of the Sprague Hoist Division, Shepard Electric Crane & Hoist Co., New York City, was elected chairman of the association, and H. J. Fuller, Yale & Towne Mfg. Co., Stamford, Conn., was elected vice-chairman. Two companies were elected to membership—the American Engineering Co., Philadelphia, Pa., and the Chisholm-Moore Mfg. Co., Cleveland, Ohio. A report was submitted that showed that electric hoists are now being used in ninety-five distinct industries.

In addition to the regular statistical work of the association, which includes the gathering of information regarding the number and value of hoists ordered each month, segregated under standard rating sizes, and monthly value of shipments, a plan has been inaugurated for collecting information regarding inquiries for hoist quotations. An effort is being made by the association to determine the relation that exists between the number of inquiries and the number of orders.

* * *

GERMAN MACHINERY INDUSTRY

According to official statistics, Germany had in 1925 close to 16,000 factories engaged in the building of machinery of all kinds, with a total annual producing capacity of $1,200,000,000. The annual value of the production in 1925, however, was only $690,000,000, indicating that the industry did not work to fully 60 per cent of its capacity; 29 per cent of this production was exported. The total number of men engaged in machine-building factories was 612,000, or an average of about 38 workers per factory.

For comparison, it may be stated that the number of factories engaged in machinery building in the United States in the same year was 8150, with an annual estimated producing capacity of $4,000,000,000, the annual production in 1925 being $2,233,000,000, or 55 per cent of the estimated capacity. Of this production, 6.7 per cent was exported. The number of workers in these factories in the United States was 481,000, or an average of 59 workers per factory. Great Britain's machine-building capacity is estimated at $825,000,000 per year.

* * *

GENERAL ELECTRIC ENCOURAGES THRIFT

The fifth annual report of the General Electric Employes Securities Corporation shows that over 27,000 of the employes of the company hold bonds in the corporation, the average holding being about $1000. In addition, 5000 employes are now buying bonds of the corporation on the installment plan; $1,647,500 was paid the bond-holders in interest during 1927.

Milling Keyways in Line on Long Shaft

By HOWARD ROWLAND

THE particularly interesting feature of the keyway milling job illustrated in Figs. 1 and 2, is the method of automatically cutting the three keyways *J*, *K*, and *L* in line on one side of a shaft which is longer than the milling machine table travel. The work was done on a No. 5 high-power Cincinnati miller equipped with the regular table feed mechanism and the intermittent feed control device shown in Fig. 1. The only special equipment required was a set of three table dogs Nos. 1, 2, and 3, Fig. 2, which are simple in design and cost very little to make.

The method of milling the keyways in the long shaft will be more clearly understood by referring to Fig. 2, which shows the shaft in position before the milling cycle is started, with the cutter at the starting position *A*. By shifting the feed-lever to the left, the table is automatically traversed to the left until the cutter reaches the position *B*. The feed is then automatically engaged by a standard dog and continued for milling the first keyway, until the cutter takes the position *C*. Here the table is automatically stopped by the special dog No. 1, which determines the length of the first keyway.

The machine table is next lowered by the operator to clear the cutter, and the rapid advance is again engaged until a combination of a standard dog and the special dog No. 3 automatically stops the table with the cutter located at the starting point *D* for cutting the second keyway. The operator then raises the table until a dial gage shows that the depth setting is correct for milling the second keyway, after which the feed is engaged by hand. The second keyway is milled to length when the cutter reaches the position *E*, after which the table is again automatically stopped by a standard dog, which determines the length of the second keyway.

At this point in the cycle of operations the table is not lowered but instead, the work is loosened in the fixture, leaving the cutter in its milling position at *E*. The rapid return movement of the table is then engaged, and the table traversed to the right until the cutter is again in the position *D*. Since the traverse feed is still engaged, the cutter moves the work along in the fixture until the rapid return movement is automatically stopped by the special stop dog No. 2, which is set to the proper position on the table. This automatic movement of the work along the fixture determines the starting point of the third keyway and brings the work into the position on the fixture shown in the lower view, Fig. 2.

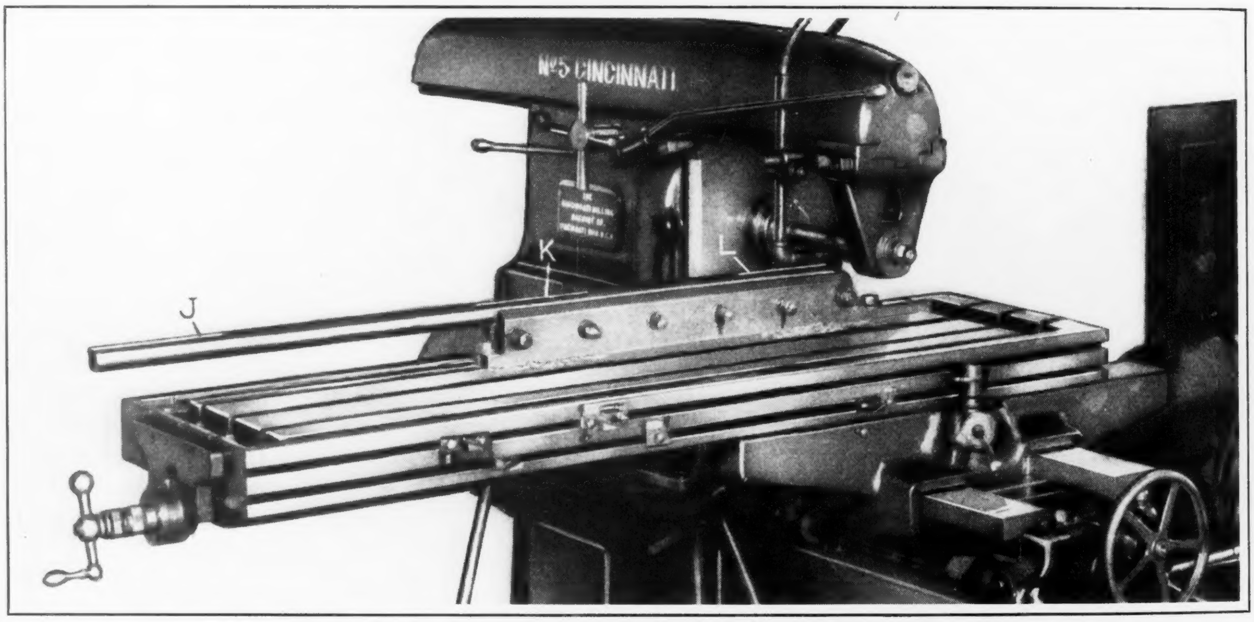


Fig. 1. Milling Keyways in a Long Shaft

With the cutter still in position in the second keyway, the work is again clamped in the fixture. The table is then lowered and advanced rapidly to the left until the combination standard dog and special dog No. 3 again automatically stops the table, bringing the cutter into the position shown at *G*, which determines the starting point in milling the third keyway. The operator then raises the table to the same dial setting used for the other keyways and engages the feed for milling the third keyway. Next, the table is fed to the left until it is stopped automatically with the cutter at point *H*. A standard table dog is used to stop the table after the third keyway has been completely milled.

The next step is to engage the rapid return movement, the table then being run to the right until it is automatically stopped by the standard dogs at the extreme left-hand end of the table. In this position, the gang cutters are in position *A*. The special dog No. 2 is of the flipper type, and can be

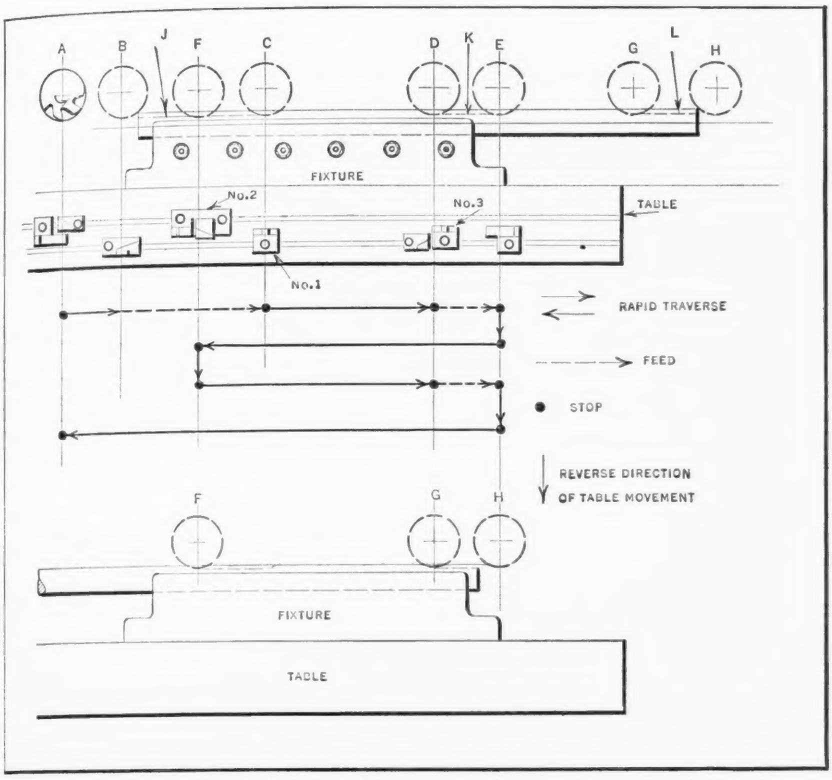


Fig. 2. Diagram of Table Movements in Milling Keyways in Long Shaft

raised by the operator to clear the feed-engaging plunger, so that the table will continue its return movement until it reaches the starting position. Should the operator fail to raise the special flipper dog No. 2, the table will be automatically stopped with the cutter at the position *F*.

The advantage of the method described is that the keyways can be automatically spaced along the shaft with a maximum variation of only 1/32 inch. In checking the alignment of the third keyway with the first and second keyways, it was found that the maximum variation was only 0.001 inch. Another advantage of the method described is that the lengths of the keyways can be varied at will by setting or adjusting the table dogs. The same method could be used for milling four or more keyways in line along the side of a shaft of much greater length than the table travel. In this case, it would only be necessary to make use of additional standard and special table dogs.

* * *

Before the war the railroads of Italy had a reputation for being among the least satisfactory to the traveling public in Europe. Today, conditions have changed entirely. Under the Mussolini régime, the Italian railways have greatly improved and give evidence of a remarkable efficiency. It is stated that they now rank among the best administered and operated railroads in Europe.

MILLING FIXTURE FOR CONNECTING-ROD

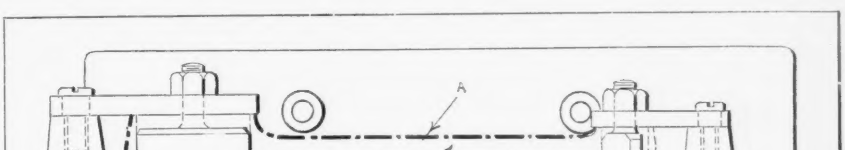
By EDWARD T. HEARD

A fixture for use in milling the parallel and the tapered sides of automobile engine connecting-rods is shown in the accompanying illustration. The fixture, as will be clear from the illustration, holds two connecting-rods. One of the rods *R*, as shown by heavy dot-and-dash lines, is located in the correct position for milling the parallel sides *A*.

The other rod is located on a pivoted holder *H* which can be swung on the pin *D* to bring the connecting-rod into position for milling the tapering sides *B* and *C*. The key *E*, when placed in slot *F*, locates holder *H* for milling side *C*. The holder is located for milling the other side *B* of the rod when key *E* is placed in slot *G*. The clamps which hold the connecting-rods in place are clearly shown in the illustration.

* * *

It is estimated that at the present time there are over 170,000 gasoline filling stations in this country. Pumps and other equipment required for such stations are needed in such great quantities that an entirely new and important industry has been created. This, in turn, creates a demand for much new shop equipment.



Fixture for Use in Milling Sides of Connecting-rods

What MACHINERY'S Readers Think

Brief Contributions of General Interest are Solicited and Paid for

PROVIDING CHAIRS FOR WORKMEN

Commenting on the question of chairs for workmen, I believe that they should be provided when the work does not require that the man stand up all the time. If it is not necessary, why should a man be tired out standing on a hard floor all day? A tired body is not conducive to good work. Men working on boring mills, lathes, or millers, for instance, need not stand up between set-ups, as they can watch the tool just as well sitting down.

The custom of having a man stand up all day is inherited from the past, when most shop work was physical work. Today many jobs require more brains than physical strength, and the man with a rested body can do better and faster work and will be more contented as well. C. A. MARTYN

DESIGNERS SHOULD CONSULT OPERATORS

Commenting on the article entitled "Designers Should Consult Operators," on page 575 of April MACHINERY, the writer would say that a point worth stressing is that the man who actually operates a machine soon becomes aware of details in its construction that are likely to be overlooked by a designer. The operator, because of his close contact with the machine, recognizes the value of any particular feature in design, and can, therefore, give an intelligent estimate of the best points of design in the different makes that he has been operating. He notes the variation in the amount of energy that must be expended in operating different makes of machines to produce the same amount of work. Any efficiency expert will readily admit that the time required to do work on different machines varies with the energy expended in operating the machines, even though the accuracy and durability, as outstanding features, may be the same. A TOOLMAKER

REFERENCES FROM PAST EMPLOYERS

I concur with Sam Wright in his views on page 518 of March MACHINERY. A written reference, unless the applicant is a stranger in a particular part of the country, is of comparatively little value in my opinion. I favor the telephone reference. Then specific questions can be asked and the former employer will express himself more freely than he would in a written statement. The prospective employer or employment manager, if alert, can easily detect from the manner in which the former employer presents his statements whether they appear to be unbiased or not. He can ask the applicant for his side of the story, and then he can usually reach a fairly accurate conclusion. Many a good man has been unjustly handicapped by the attitude of a former employer, and it is well to obtain the true facts, if possible. On the other hand, an applicant who seems to have always been discriminated against in his former jobs (according to his own story) is a good man not to employ. Even personal history has a way of repeating itself.

STANLEY J. GUSTOF

TECHNICAL JOURNALS IN THE ENGINEERING DEPARTMENTS

Samuel Kauffman's article on page 517 of March MACHINERY brings out an important point. If manufacturers would see to it that their designers and draftsmen thoroughly studied technical journals, they would many times be able to avoid waste of time in their engineering department. Very often time and effort is spent on "inventing" something in the drafting-room, for use in the shop, that is already available commercially. Anyone with extensive experience in an engineering department can recall instances where a draftsman puzzling over a design was asked by someone better informed "Why don't you use So-and-So's product? It will do the same thing and it is much cheaper to buy than for us to manufacture."

Investigation discloses that the better informed man saw it advertised in the pages of a technical journal. There is no greater waste than to design and build something that is already available on the market and that has gone through the development phase and is a successful commercial product. The commercial product, as a rule, is not only cheaper, but better. Any firm that invests in a few worthwhile technical journals, handing them over to a selected list of their engineers and shop executives, is likely to reap handsome dividends in the form of greater economy in shops and drafting-rooms. EDWARD R. MILLER, JR.

WANTED—A MACHINE BUILDERS' FEDERATION

Recent issues of *Commerce Reports* describe the activities of the German Machinery Manufacturers' Association, which is a federation of the trade associations in the machinery field, including the German Machine Tool Builders' Association. The latter has a widespread influence in Germany, and receives substantial support from the manufacturers in that branch of the industry. It owns its own office building and also its own exhibition building at the Leipzig Fair, and has contributed testing equipment to the machine tool laboratory at Charlottenburg valued at half a million dollars.

I believe that it would be to the interest of American machinery manufacturers to be organized along the same lines as the German manufacturers. Would not a federation of American machinery builders along the same lines, and engaged in similar activities to the German Machinery

Manufacturers' Association, be of great help to American machinery builders? There are many problems common to all manufacturers of machinery, apart from the specific problems of each branch of the industry. The German federation dates back to 1892—thirty-six years. The fact that it is still apparently very active indicates that it is serving a useful purpose.

The National Machine Tool Builders' Association, it is safe to say, is the most active organization of industrial machinery builders in this country. Would it not be possible for other American machinery industries to profit from equally active organizations? OBSERVER

SKILL AND BOOK KNOWLEDGE

During the eighteenth century, machines for metal cutting were practically unknown. A machinist or "millwright" worked principally with a hammer, chisel, and file. Skill in the manipulation of these tools was his "stock in trade." The crude treadle-operated "pole lathe" was the common type of machine used for turning. Its operation required considerable skill, but it was of little value for metal cutting. A few crude metal drilling and boring machines were in use, but there were no planing machines or other mechanical devices for producing flat surfaces.

The dawn of the nineteenth century found the world ready to move forward, and it had to go on wheels, for civilization in its physical development is largely machine made. During the first half of the nineteenth century, most of the fundamental types of machine tools used today were invented. Machines rapidly replaced men's hands and performed many operations not practicable by hand; this resulted in a great change not only in the kind, quality, and number of machine-made products, but in the relation between the machinist and his work.

The eighteenth century millwright who used hand tools for forming flat surfaces and for many other kinds of work had to depend almost entirely upon personal skill acquired by long practice. The invention of machine tools for producing flat surfaces and for performing various other operations all tended to increase the value of shop practice knowledge and lessen the importance of manual skill, and the importance of this change is increasing continually. Highly developed machine tools, cutters, steels, abrasives, holding appliances, cutting compounds, measuring tools—these and many other classes of machine shop equipment—make it essential for machinists and shop executives to know much more than their predecessors.

Thus precise knowledge has largely replaced mere skill in modern shop practice, and most of this information is of such a definite character that it can be presented by means of periodicals and books better than in any other way. Nevertheless, some mechanics of the old school still look askance at a book or articles on machine shop practice, because to them trained hands are far more important than a trained head. But the progressive shop man of today—whether superintendent, machinist, or apprentice—realizes that knowledge of efficient tool equipment and of the best methods of applying it is the most essential requirement for advancement to a higher position.

Even a small investment in helpful knowledge is sure to pay profitable dividends. Any number of MACHINERY will prove this. Such an investment has always been "gilt edged," but its value is much greater now than at any period in the history of mechanical progress. SHOP FOREMAN

SHOP TRAINING FOR DRAFTSMEN

One superintendent complained to another about the increasing lack of practical knowledge among draftsmen. "The present-day draftsmen," he said, "are much better grounded in mathematics and mechanics, but know less about shop operations than the draftsmen of the past." For the better technical grounding he was duly grateful, but he would like to see more knowledge of shop practice.

His fellow superintendent agreed with him, but mentioned a solution that had partly solved the problem in his shop. He said "When the shop reports errors or suggests changes on drawings, I call them to the attention of the draftsman responsible. That, however, corrects only one man, or possibly two, if we include the checker. If I call the error to the attention of all the men, it reflects unnecessarily on a good but sensitive man. Furthermore, it is important to give the man something that fixes the matter in his mind, such as the number of extra hours spent on the operation in the shop, the cost of special tools needed to do the work his way, as compared with the new way, the cost of scrapped parts due to an error, etc. It is these details that create the mental shock necessary for remembering a thing.

"To accomplish my purpose, I invite the shop foremen to meet the draftsmen periodically and to tell them of the shop man's difficulties. Only one foreman is present at a session and I discuss the points briefly with him in advance. There is plenty of discussion and no formality, and to keep the thing on the right track, I act as unofficial chairman. When the draftsmen are told of the grief caused by the sharp corners in a keyway in a highly stressed shaft or the cracks developed in heat-treating incorrectly designed dies or tools, it makes a deeper impression than the changing of a few lines on a drawing. Furthermore, and this is of primary importance, a better spirit is built up between the shop and the drafting-room, through a better understanding of the other fellow's viewpoint." JOHN F. HARDECKER

WHEN PURCHASING DEPARTMENTS LEAN OVER BACKWARD

It is the proper function of the purchasing department of a manufacturing establishment to buy as cheaply as possible, but "as cheaply as possible" does not necessarily mean, in every case, that the price paid should be the lowest possible in dollars and cents. There are many other points to be considered in buying, and the real function of the purchasing department is not merely to make the lowest possible expenditures, but rather to make expenditures intelligently for the most profitable conduct of the business as a whole.

An example will illustrate this point. Recently a machine tool manufacturer was asked to quote on a repair part for one of his machines. He quoted $12. A letter was received, in answer, stating that he had formerly quoted $10. After going through his correspondence for two years and finding no such quotation, he informed the customer to that effect. In reply, a letter was received, with a photostat of a quotation that had been made two and one-half years ago, when, due to the fact that a lot of machines of the type for which the repair part was required was just then being put through, it was easy to add an extra part to the lot and machine them all together. In view of the past quotation, however, the machine tool builder reduced his figure and supplied the part.

Meanwhile, however, a machine costing several thousand dollars stood idle for more than a week in the customer's plant while the purchasing department dickered over a matter of $2. The expense of the correspondence, the making of the photostat, and the clerical work easily amounted to more than the $2 saved, not to speak of the loss caused by the idle machine. Such purchasing methods are not economical. They involve an actual loss to the buyer.

In another instance, four telegrams were exchanged in the purchase of a small part costing a few dollars. The two telegrams sent by the buyer amounted to more than half the cost of the article, and the two replies that the machine tool builder was forced to send by wire took all the profit out of the transaction, so that the sale actually resulted in a loss.

The freedom with which the telegraph is used when a letter would do as well is really astounding. It is quite evident that the charges for telegrams are not scrutinized with the same care as the quotations made by machine tool builders.

MACHINE TOOL MANUFACTURER

A COMMENT ON ENGINE LATHE DESIGN

Great improvements have been made in engine lathes, as well as in other machine tools, during recent years. In giving manufacturers full credit for these improvements, the writer ventures to make a suggestion which may further improve the usefulness of this "king of machine tools."

Many builders of geared-head lathes have left out the feature that permits the machine to be reversed. Perhaps it is believed that the running of an engine lathe clockwise is unnecessary now, because of the introduction of chasing dials, but the reversal of the lathe may be necessary at other times than when cutting threads. There are many jobs that are more easily handled by having the machine run in a clockwise direction. It assists greatly in putting on and taking off heavy chucks and faceplates.

There are many shops in which dies of the kind used in stocks for bench work are employed in the lathe instead of cutting the threads by chasers. The dies are held in a fixture that fits into the spindle of the tail-center. The tailstock is left free to slide on the bed of the machine, and the thread is cut as in an ordinary bolt cutter. The reverse movement of the machine is then used to back off the die. On small jobs this method of cutting threads saves a great deal of time. ALBERT MILTON THOMAS

WHAT IS EXPERT ADVICE?

The subject "What is Expert Advice?" previously discussed in these columns is of particular interest to me. One viewpoint that I would like to emphasize is that a great many of the ideas presented by the so-called expert in the report of his investigation are often obtained from the shop foremen themselves, but presented in a more clear and definite manner to the executive. The expert gets the credit for the suggestion if it is adopted. If half the consideration were given to the suggestions and recommendations of the men in the organization that is given to the recommendation of experts, there would be fewer industrial establishments where the services of an expert would be required. A. EYLES

There are many points in connection with the discussion of expert advice that might well be considered. A point I would like to bring out is that it is one thing to devise a machine or apparatus and quite another thing to use it skillfully. Furthermore, continued use will bring out possibilities for improvement that even an unskilled workman will note. A workman who has had years of actual experience on a special kind of work is himself an expert, and is often able to offer advice on improvements and to point out defects. Unfortunately, his suggestions are not always accepted in a friendly spirit, and this makes him reluctant to offer suggestions.

Why not bring the technical expert and workman together in consultation? The greatest mistake an executive can make is to think that he cannot accept suggestions or advice from skilled workmen. WILLIAM SPONSLER

There is one point in the discussion on the qualifications of outside experts that ought to be emphasized. From some of the expressions previously published in MACHINERY, it might be thought that the engineering expert whose advice is sought should be able to step into the shop and operate any specified machine in connection with which his advice may be required. In many instances, this would be an erroneous method of judging the qualifications of the men.

It is evident that engineers who devote their time exclusively to the study of engineering principles and methods for obtaining specific results by the use of these principles may not have a great deal of actual shop practice. Certainly, in only a few instances, are they skilled mechanics. However, their skill in designing mechanisms may be very great. Many of the foremost engineers of the present day in fields where the most remarkable advances have been made—the designing engineers in the automotive field and in the electrical industries—have very little direct shop experience. On the other hand, of course, if the expert advice is sought on a question of machine shop practice, naturally, a man with extensive shop practice is required. PETER HAGEN

Special-purpose Flat Surface Grinding

By CHARLES O. HERB

SINGLE-PURPOSE machine tools usually have a greater initial cost than standard machines, but when the conditions are suitable, this first cost is justified by the higher rates of production and lower piece costs obtainable with the machine designed to meet the needs of the individual job. However, the volume of work should be sufficient to keep the single-purpose machine in constant operation. Another important factor to remember is that the special machine should be of such a design that changes likely to be made in the product will not render the machine obsolete before substantial savings have accrued from the investment.

For several years, the Gardner Machine Co., Beloit, Wis., has designed and built many special-purpose flat surface grinding machines for operations in which conditions are such that special machines are obviously more economical than those of standard design. These machines have varied from a small bench type using two 10-inch wheels, to a double-spindle machine equipped with 53-inch abrasive disks. The majority have been built for operations in which the work must be ground to specified dimensions within close limits. Some of the most important of these special machines will be described in this and a subsequent article. In some examples, only the work-feeding mechanisms are special, while in others, practically the entire machine has been designed for the particular job to be done on it.

Grinding Large Boiler Castings

Machines of the types dealt with in this article are often considered suitable for finishing comparatively small parts only, whereas large work such as illustrated in Fig. 2, can frequently be handled to advantage. This part is a boiler casting 40 inches long by 22 inches wide. The narrow surfaces seen finished in the illustration are ground simultaneously on both sides of the casting as it is reciprocated three times between two abrasive disks on the machine shown in Fig. 1. About 3/32 inch of stock is removed from each side of the casting, and the finished surfaces must be parallel for the entire length within an amount that varies from 0.006 to 0.012 inch on the different parts. The production averages twenty-four castings per hour.

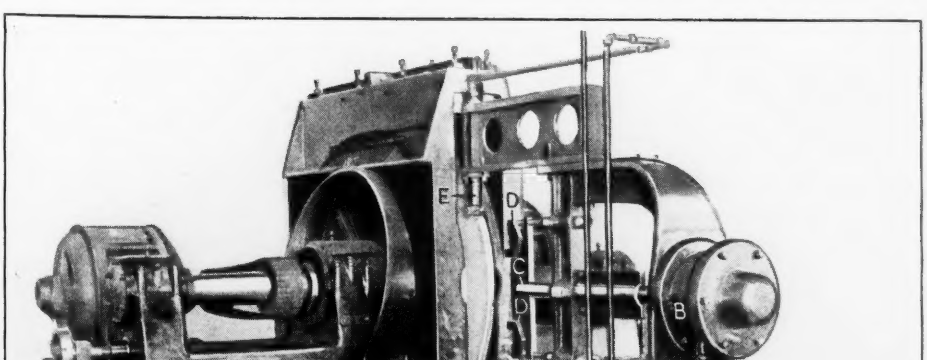


Fig. 1. Special Hydraulically Operated Machine Equipped with Two Abrasive Disks for Simultaneously Grinding Both Sides of Boiler Castings

For the operation, the casting is securely held in a table fixture which is shown in Fig. 1 part way between the abrasive disks. The casting is seated on two hardened steel plates, one of which may be seen at *A*. The closed end of the casting abuts against the solid frame of the fixture. While the casting is held vertical in this position by the operator, a lever is moved to admit air into cylinder *B*, thus causing the pneumatic clamp *C* to advance and grip the work lengthwise. The work is actually clamped by the hinged equalizing mem-

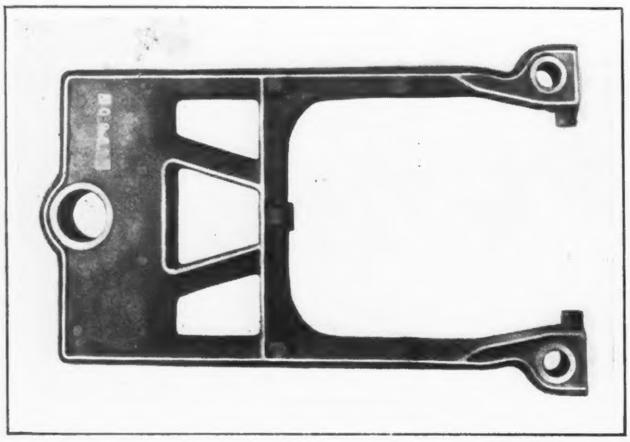


Fig. 2. Comparatively Large Iron Casting Finished by Abrasive Disks on the Machine Shown in Fig. 1

bers *D* attached to member *C*. Four air-operated clamps then descend from the top of the fixture frame and exert pressure along the upper edge of the casting. One of these clamps may be seen in the illustration at *E*.

The table on which the fixture is mounted is actuated hydraulically back and forth between the grinding disks. As these reciprocations take place, the disk heads are automatically moved toward each other about 1/4 inch, and at the end of the three reciprocations, when the finished work is withdrawn, the heads again open this amount. The movements of the grinding heads are also accomplished hydraulically.

Only one lever is employed in controlling this machine. It is moved a certain amount to actuate the clamping devices and is moved farther to start the table traverse. When the table reaches a certain forward position, oil is automatically entered into a cylinder for feeding the grinding disk heads toward each other. At the end of the three table reciprocations, the work-table recedes to the loading position, where it stops automatically and the piece is automatically released. G.I.A. abrasive disks 53 inches in diameter are used on this machine. Coolant is not required in grinding these large boiler castings.

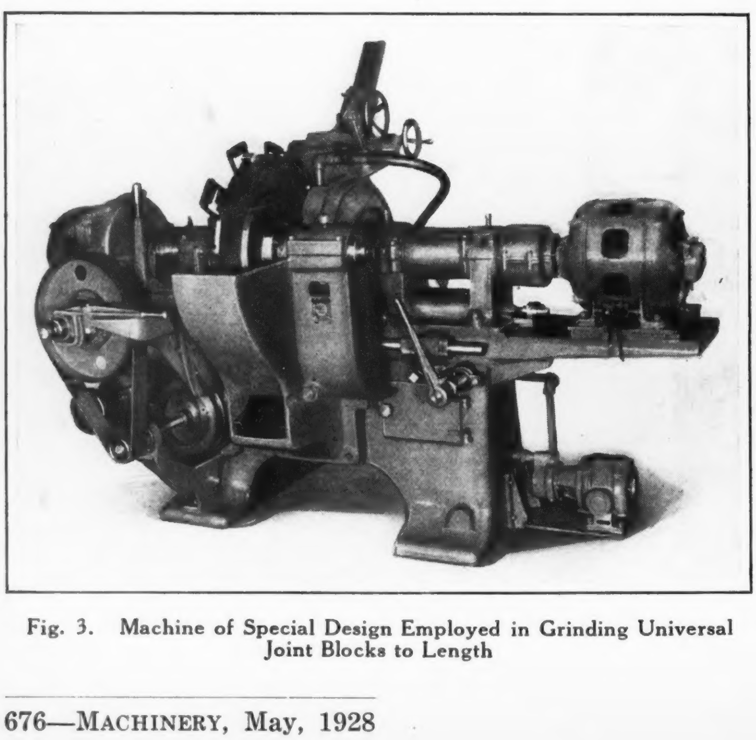


Fig. 3. Machine of Special Design Employed in Grinding Universal Joint Blocks to Length

Universal joint blocks are ground simultaneously on both ends by two ring wheels on the machine shown in Figs. 3 and 4. The nature of the work may be clearly seen at *A* in the latter illustration. Each end surface is held to length relative to the center of the hole within limits of plus or minus 0.0005 inch. Furthermore, the two ends must be parallel within 0.001 inch. From 0.005 to 0.008 inch of stock is removed from each end. The production ranges from 5 to 20 blocks per minute, depending upon the size of block being handled. This operation is performed wet.

When the steel blocks come to this grinding machine, they have been ground all over with the exception of the ends. Hence, they can be accurately seated in V-blocks *B* which are spaced around car-

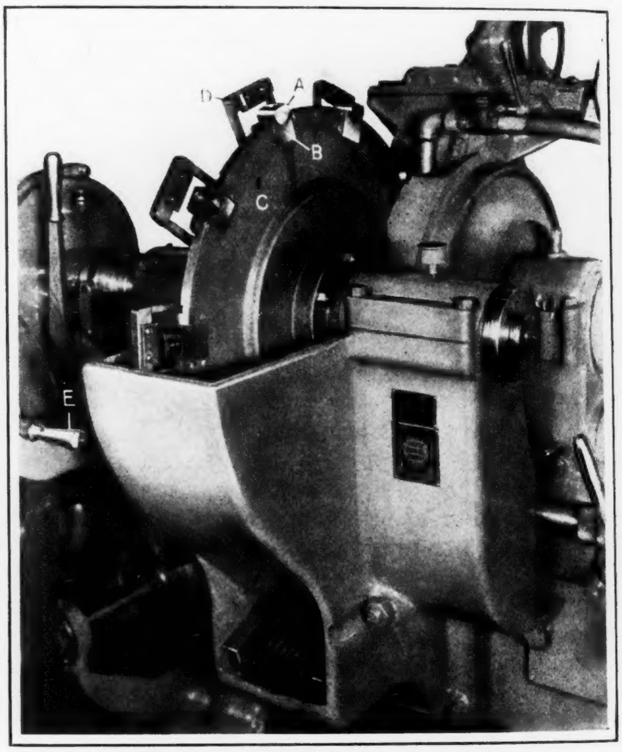


Fig. 4. Carrier Unit which Conveys the Universal Joint Blocks between the Grinding Ring Wheels

rier *C*, the hole in each block being seated over a plug. As the carrier revolves and takes each block toward the grinding wheel, a cam first swings the corresponding hinged clamp *D* centrally over the piece and then pulls the clamp tightly down on the piece for the passage between the grinding wheels. When the operation has been completed, the clamp automatically reopens and the part falls on a chute, which carries it to the front of the machine, as may be seen in Fig. 3.

In this operation, there is no lateral movement of the abrasive members, a shear cut being taken. This shear cut tends to keep the wheels dressed. As wear takes place on the wheels, the wheelheads can be adjusted longitudinally to compensate. Operation of the work carrier is controlled through a horizontal lever, one end of which can be seen at *E* in Fig. 4. The carrier is motor-driven through speed-reducing belt drives and a

gear-box. Various speeds are obtainable to suit the work. Separate motors are employed for driving the wheel-heads, while a fourth motor drives the water pump. The ring wheels are 20 inches in diameter.

Finishing Four Faces of Connecting-rods

A machine of somewhat similar design is shown in Fig. 7 arranged for grinding all four bearing faces of automobile connecting-rods at one pass of the rods between two G.I.A. grinding disks. Approximately 1/32 inch of stock is removed from each face, and the faces are held within plus or minus 0.002 inch of the specified thickness. The production averages five rods per minute.

Each end of the connecting-rods is seated on V-

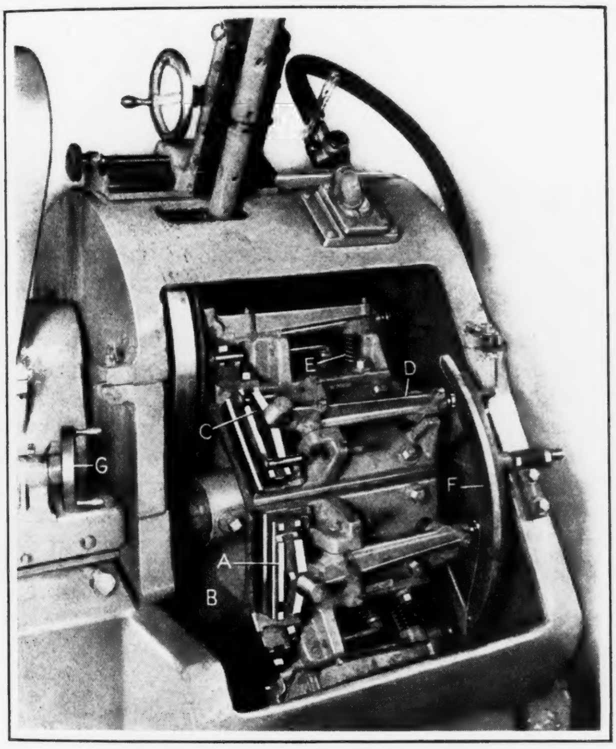


Fig. 5. Close-up View of the Carrier on the Machine Shown in Fig. 8, with its Valve Tappet Clamping Mechanisms

blocks on the carrier and held securely in the vees by clamps which act on the rod ends. These clamps may be seen at *A* and *B*. When the clamps of any carrier station reach the front of the machine, they are automatically opened to permit loading a rod as shown. Then, as the rod is carried toward the grinding disks, the clamps are automatically pulled down to hold the rod firmly during the grinding process. The clamps are opened by means of a cam. Guides *C* and *D* hold each rod in the V-blocks until the clamps descend on it. After the rods leave the grinding disks, the clamps also automatically release to permit the rods to fall into a chute, which conveys them to the front of the machine, as shown at *E*.

This carrier mechanism is also driven by a motor, operating through two "Texrope" drives and a gear-box, which give the desired reduced speeds. The carrier is controlled through lever *F*, which is connected to a treadle for hand or foot operation. Lever *G* disengages the clutch that drives the carrier shaft. The grinding disks are 23 inches in

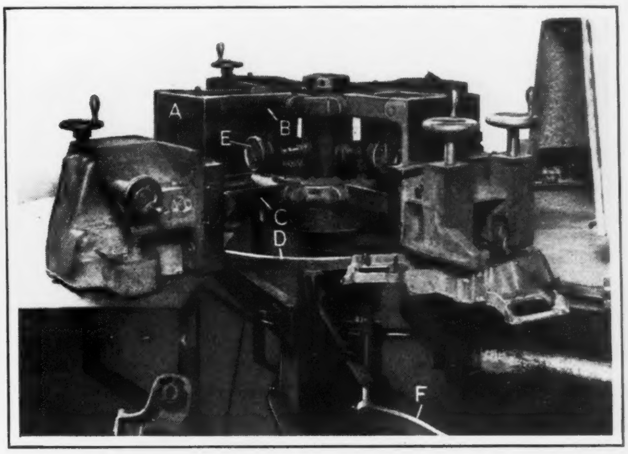


Fig. 6. Vertical-spindle Machine Arranged for Grinding Four Different Parts in Sequence

diameter. A shear cut is also taken in this operation, and therefore there is no lateral movement of the disk heads, but independent wheel adjustments are provided to compensate for wear.

How Valve Tappet Heads are Ground

In all the examples so far presented, two sides of the work are ground simultaneously. Figs. 5 and 8 illustrate a machine designed for effecting economies while using only one abrasive member. The operation consists of grinding the heads of automobile valve tappets. These parts are made of a tough steel, with the head welded to a stem. Approximately 1/16 inch of stock is ground off and the pieces are held to length within limits of plus or minus 0.010 inch. The production averages eight or nine tappets per minute. This operation is performed with an 18-inch ring wheel.

From Fig. 5 it will be seen that the tappets are held on the vees of a block *A* mounted on each of the octagonal sides of drum *B*. They are located by the finished under side of the heads coming in contact with a ground surface on blocks *A*, although fixtures have been built in which the tappets are located from the stem end. Two tappets are held on each block by an equalizing clamp *C*, which is free to swivel a limited amount on the forward end of a lever *D*.

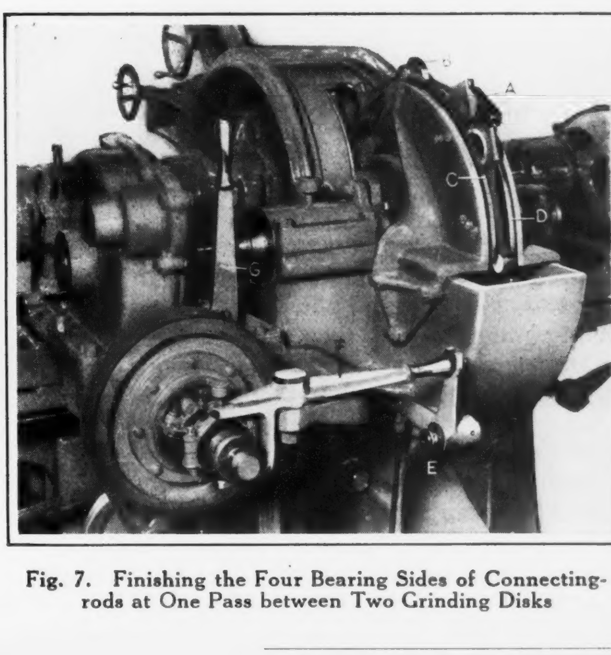


Fig. 7. Finishing the Four Bearing Sides of Connecting-rods at One Pass between Two Grinding Disks

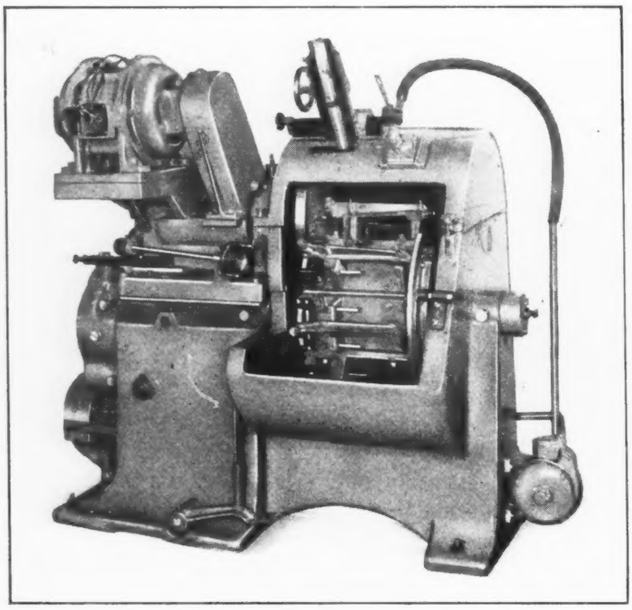


Fig. 8. Construction of a Machine Built Primarily for Grinding the Heads of Automobile Valve Tappets

Normally, the right-hand end of each lever *D* is held up through the action of a spring *E*, so as to push the corresponding clamp *C* down firmly on the two tappets and hold them securely during their movement across the grinding wheel. However, as the clamping units reach the front of the machine after the operation, a roller on the end of each lever *D* comes in contact with the under side of cam *F*, and causes the levers to be depressed. This raises the clamp *C* to permit reloading of the work. The wheel can be fed accurately toward the work by graduated handwheel *G*, to compensate for wear.

Special Machine for Handling a Variety of Work

Electric washer parts are ground on one side on the vertical-spindle grinder shown in the heading illustration and in Fig. 6. This machine is equipped with a four-station work carrier which conveys the work from a loading table across the horizontal face of the grinding disk and back to the loading table. At each station of the carrier there is a fixture that holds the work properly to suit the operation. The four fixtures may be alike to permit grinding one part on one side, or they may be different to permit grinding the same part on several sides. Also, different parts can be handled at one time by providing suitable fixtures. Production rates vary from 14 to 28 pieces per hour.

The fixtures shown in the illustrations are for grinding the four different parts seen lying on the floor in the heading illustration. These parts are iron castings. From 1/32 to 1/16 inch of stock is removed from each surface. As in the preceding examples, the operator's work consists merely of loading and unloading the fixtures. Housings, housing supports, wringer drive boxes, covers, and short legs are typical parts handled by this equipment.

A particularly interesting feature of construction of this equipment is that the vertical work-tables *A*, on which the various fixtures are mounted, are hinged to a central unit of the carrier through toggle links, such as shown at *B* and *C*. The construction is such that no matter what the position of the toggles, the machined face of the corresponding table *A* is always in a true vertical plane at right angles to the grinding member. A roller on the back of each table runs on track *D* and thus controls the vertical position of the table. The track is so constructed that the work clears the loading table slightly as it is conveyed over it, and when the abrasive member is reached, the work is gradually lowered on it and then conveyed straight across until finished.

Micrometer vertical adjustments of tables *A* and their work-holding fixtures to compensate for wear of the grinding member are obtained by turning the corresponding handwheel *E*. Each fixture is furnished with proper locating and quick clamping means designed to meet the conditions of the individual part. The carrier is driven from the spindle of the machine through bevel gears and three-step cone pulleys which furnish different speeds. Lever *F* is manipulated to engage or disengage the clutch that controls the rotation of the carrier. This machine is equipped with a 53-inch G. I. A. abrasive disk.

* * *

FRENCH STANDARDS FOR SMALL SCREWS

The screw thread standard Systeme Internationale, ranging from 6 to 80 millimeters diameter inclusive, is established as standard in France. For sizes below 6 millimeters there is (1) a precision series (Série de la petite Mecanique), which is established as a definite French standard; (2) a series for the watch- and clock-making industry (Série Horlogere). The last-named series, which is for screws below 2.5 millimeters diameter, is that recommended by the Société d'Encouragement pour l'Industrie Nationale.

System	Diameter, Millimeters	Pitch, Millimeters
Watchmaker's standard	0.40	0.11
	0.45	0.11
	0.50	0.13
	0.55	0.13
	0.60	0.15
	0.65	0.15
	0.70	0.17
	0.75	0.17
	0.80	0.19
	0.85	0.19
	0.90	0.21
	0.95	0.21
Watchmaker's and precision standard	1.00	0.24
	1.10	0.24
	1.20	0.27
	1.30	0.27
	1.40	0.30
	1.50	0.30
	1.60	0.33
	1.70	0.33
	1.80	0.36
	1.90	0.36
	2.00	0.39
	2.10	0.39
	2.20	0.42
	2.30	0.42
	2.40	0.45
	2.50	0.45
Precision standard	3.00	0.60
	3.50	0.60
	4.00	0.75
	4.50	0.75
	5.00	0.90
	5.50	0.90
	6.00	1.00

Machinery

HARDENING COPPER

In *Research Narratives*, published by the Engineering Foundation, 29 W. 39th St., New York City, is published a very interesting account relating to the hardening of copper. The article was prepared by William G. Schneider of the Copper and Brass Research Association.

There exists, on the part of those not intimately connected with the working of copper, the belief that the ancients had a method of hardening that metal, with which we today are not familiar. The fact of the matter is that our present-day metallurgists not only understand how the ancients hardened their copper and bronze, but also know how to produce copper and bronze products that are even harder than those left to us and which represent the so-called lost art of hardening copper.

Cutting edges on swords, daggers, knives and other implements developed by the ancients were obtained by hammering the metal, or, in other words, cold-working. These old metal-workers not only hand-hammered their copper implements but also used the same means to harden bronze articles. The heating of many of these products in open fires resulted in the formation of considerable copper oxide, which alloyed with the copper and hardened it. One of the most common mistakes of persons who claim to have rediscovered "the lost art of hardening copper" is to heat it in a forge and in this way saturate it with copper oxide, which combines with the copper to form a much harder and more brittle product.

There are really two methods of hardening copper that are regularly practised nowadays, just as in centuries ago. One consists of alloying the copper with some other metal or several other metals, such as zinc, tin, nickel, cadmium, chromium, cobalt silicon, aluminum, iron, beryllium and arsenic; the second consists of cold-working the metal or copper alloy. In fact, it is possible to work the metal to such a state of hardness that a slight amount of additional work will cause it to break. The explanation of all copper hardening may be attributed to one of these methods or a combination of both. Photomicrographs of an ancient copper spear-head indicated that it was extremely hard and that apparently this hardness had been obtained by cold-working.

It is possible to produce copper scissors, knives, and other cutting tools, but unless a special reason exists for their use, they offer no advantages over tools made from steel. Occasionally, however, it becomes necessary to use copper or bronze tools. Around a powder plant, where all sparks must be avoided, bronze knives are almost essential.

The actual hardness of annealed commercial copper as determined by the Brinell machine is from 40 to 50. The hardness of cold-worked pure copper probably does not ever exceed 120 Brinell. The hardness of copper that has been alloyed with some other metal or a number of metals rarely exceeds 250 Brinell, although a hardness just over 300 has been attained as an upper limit. As a basis of comparison for readers unfamiliar with measurements of the hardness of metals, it may be stated that the Brinell hardness of very "soft" iron is around 80, and of steel used in common cutlery, such as in a pocket knife, about 420 Brinell.

Many persons endeavor to rediscover an art that never was lost. Unfortunately when they have evolved a hard copper they next try to find some use for it and then learn that, unless it has some special properties, no market exists. Copper wire, hard drawn, has a tensile strength of about 65,000 pounds per square inch and an elongation in 10 inches of about 1 per cent, with a conductivity of about 97 per cent. This affords some basis on which to work in endeavoring to develop the hardening of copper. If, for example, it were possible to harden copper so that the tensile strength were materially increased above that just stated, without reducing the conductivity, a worthwhile discovery would have been made.

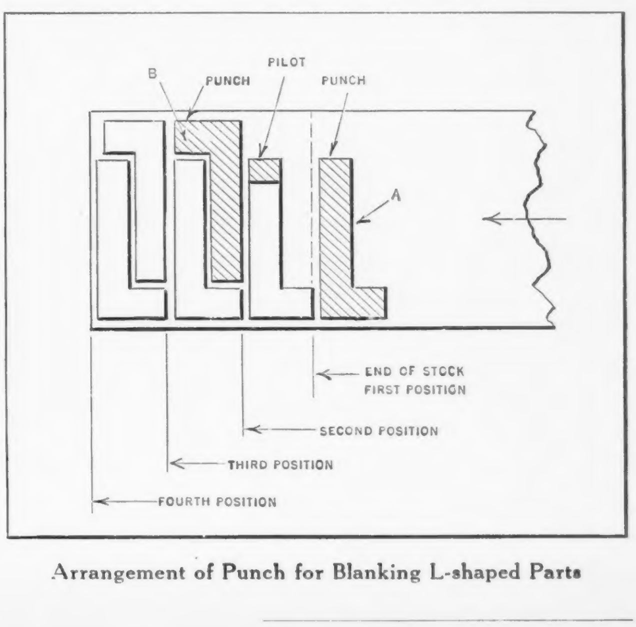
Recent methods of hardening copper by alloying are, to a certain extent, about as near to actual "tempering" as would seem possible. In these methods, silicon plays a most important part because it forms silicides with other metals which, in turn, form eutectics with the copper. The deoxidizing effect that silicon by itself exerts plays no unimportant part in finally allowing the metal to be worked and by heat-treatment to develop a high strength, with a relatively high conductivity. The latter, however, is considerably below that of pure copper and second only, speaking of alloys from the standpoint of both strength and conductivity, to those of copper and cadmium. Alloys of copper with cadmium give, for a stated conductivity, higher strengths than those with silicon.

* * *

FOLLOW-PUNCH FOR L-SHAPED BLANKS

The punching of L-shaped pieces from strip stock was accomplished in one case with very little waste material by employing the punch and die arrangement shown in the accompanying illustration. It will be noted that the two L-shaped punches shown in cross-section are located one position apart with a pilot in the space between the punches.

After the stock has been located in the first position by means of a stop, the punch *A* cuts out the first part. The stock then advances to the second position, where the pilot enters the slot just cut. At the third position, punches *A* and *B* cut out two blanks simultaneously. Two pieces are then blanked out at each succeeding stroke of the press.



Arrangement of Punch for Blanking L-shaped Parts

Pneumatically Controlled Continuous Drilling Machine

By R. E. McCOY

AIR-OPERATED chucks have held an important place in the equipment of production machines for many years. The compressed air supply lines required for operating these chucks and for blowing out chips have proved a convenient source of power for actuating various types of work-clamping and work- or spindle-feeding devices. The extent to which such equipment has been developed is indicated by the pneumatically controlled jigs and fixtures described in the present article. This equipment is used on a continuous drilling machine for drilling two holes for feather pins in parts such as shown in Fig. 1.

The continuous drilling machine is of the rotating type having six heads which carry the drill spindles. These heads are spaced around the central column, and revolve continuously with the work-table on which the fixtures are mounted. As the spindles approach the operating position, they are withdrawn by compressed air, so that they clear the work to permit unloading and loading. Six pieces of different kinds may be drilled at one time by having one piece in each of the six stations, or all six stations may be used for drilling the same kind of piece simultaneously. With this type of machine, drill heads may be mounted on each spindle, and several holes drilled at each station. Operations such as drilling, reaming, or counterboring may be done in successive stations.

The drill spindle and jig at one station are shown in Fig. 3. Two trays or pockets are built into the table at each drilling position—one for undrilled stock and the other for drilled or finished parts. The table revolves counter-clockwise, permitting the operator to use his right hand for operating the jig and his left hand for handling the parts when the ordinary equipment is employed.

Each fixture is loaded as it approaches the operator with a part taken from the tray which revolves with the fixture. When the first loaded station returns, the drilled part is placed in the tray for finished parts and the fixture reloaded from the stock tray. The time required to complete the cycle of the machine may be increased or decreased by changing the pick-off gears which drive the feeding mechanism.

R. E. McCoy was born in 1885 and received his early education in the public and high schools of Chambersburg, Pa. In 1902 he became an apprentice at the plant of the Chambersburg Engineering Co., and at the same time began studying a correspondence course in mechanical engineering. After completing his apprenticeship, he was employed by the Southwark Foundry & Machine Co., Philadelphia, the Keystone Type Foundry, Philadelphia, and the U. S. Navy Yard, Washington, D. C., where he remained for four years. During that time he attended the evening classes in mechanical engineering at the George Washington University. Later he went to the American Multigraph Co. of Cleveland, Ohio, as draftsman and designer of tools and special machinery, and was also employed in the same capacity by the Lucas Machine Tool Co. and the Willys-Overland Co., after which he entered the employ of the Western Electric Co. of Chicago, Ill., as tool designer, specializing in jig and fixture work. Here he remained until 1914, when he became connected with the National Cash Register Co. of Dayton, Ohio, as designer of special machinery and tools. In 1918, when an efficiency engineer was appointed at the plant, he became associated with him in that work. His specialty at the present time consists of analyzing and solving production problems, covering a wide range of work from the design of special machines to the lay-out of whole departments.

Air-actuated Spindles

The spindles are raised and lowered to the working positions very quickly by means of air cylinders which operate independently of the feeding cam on the stationary column around which the central column revolves. The developed outline of the stationary cam which controls the spindle-feeding movement after the drill has been advanced by air pressure is shown in Fig. 5.

The air cylinders for raising and lowering one of the spindles are shown at *S* and *T*, Fig. 3. These cylinders are fastened to the drill heads on the center column. The pistons within the cylinders are forced down or up as required by admitting and exhausting air at the proper periods in the cycle of operations. The valve for controlling the air and consequently the movement of the spindles is located at the top of the machine. The construction of this valve is shown in Figs. 2 and 4. This air valve also controls the movements of the jigs under each spindle.

Air-controlled Jigs

The jigs are primarily air-operated compound cross-slides on which locating pins and a drill bushing are mounted, as shown in Fig. 3. These jigs have interchangeable bushings, and the travel of the top slide can be varied to suit the center distance between the holes to be drilled. In order to make the operation of this type of jig clear, let it be assumed that one of the holes has been drilled in a part with the cross-slide *R* in the position shown in Fig. 3, and that the spindle has been withdrawn by means of the air cylinder *S* until the drill clears the jig bushing.

Now let us assume that the distributing valve on the top of the machine opens a port which admits air through cylinder *N*, causing the slide *R* to be forced to the left until it is stopped by a spacing bar. This brings the work into the proper position for drilling the second hole. The spacing bar, by controlling the travel of the jig table, gives the required center distance between the drilled holes. Interchangeable spacing bars of hardened steel are made in different lengths to meet the requirements

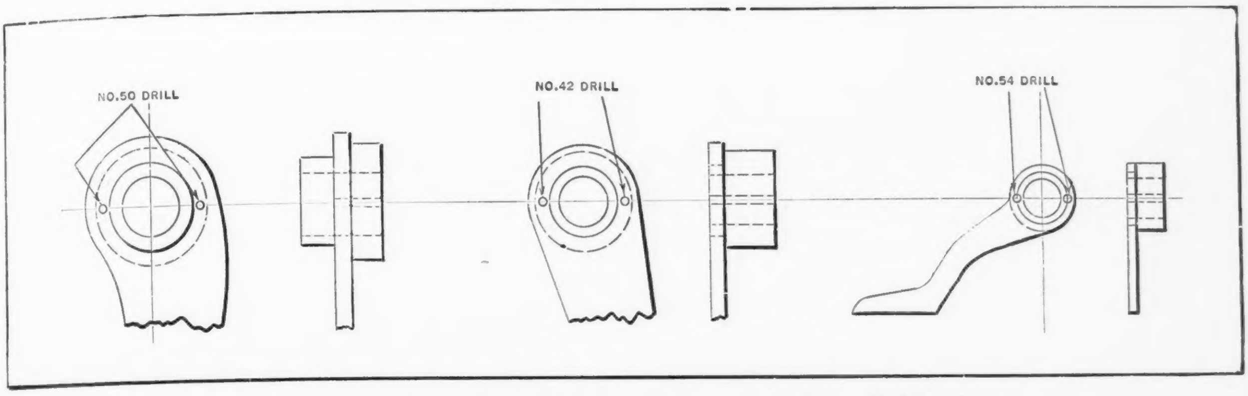


Fig. 1. Examples of Work Drilled on Pneumatically Controlled Machine

of parts in which different hole-spacing is required. The spacing bars are supported by the V-blocks *Q*.

The distributing valve then admits air to the cylinder *T* which causes the drill spindle to move down quickly. The feed cam around the center column then comes into play, and the drill is fed down

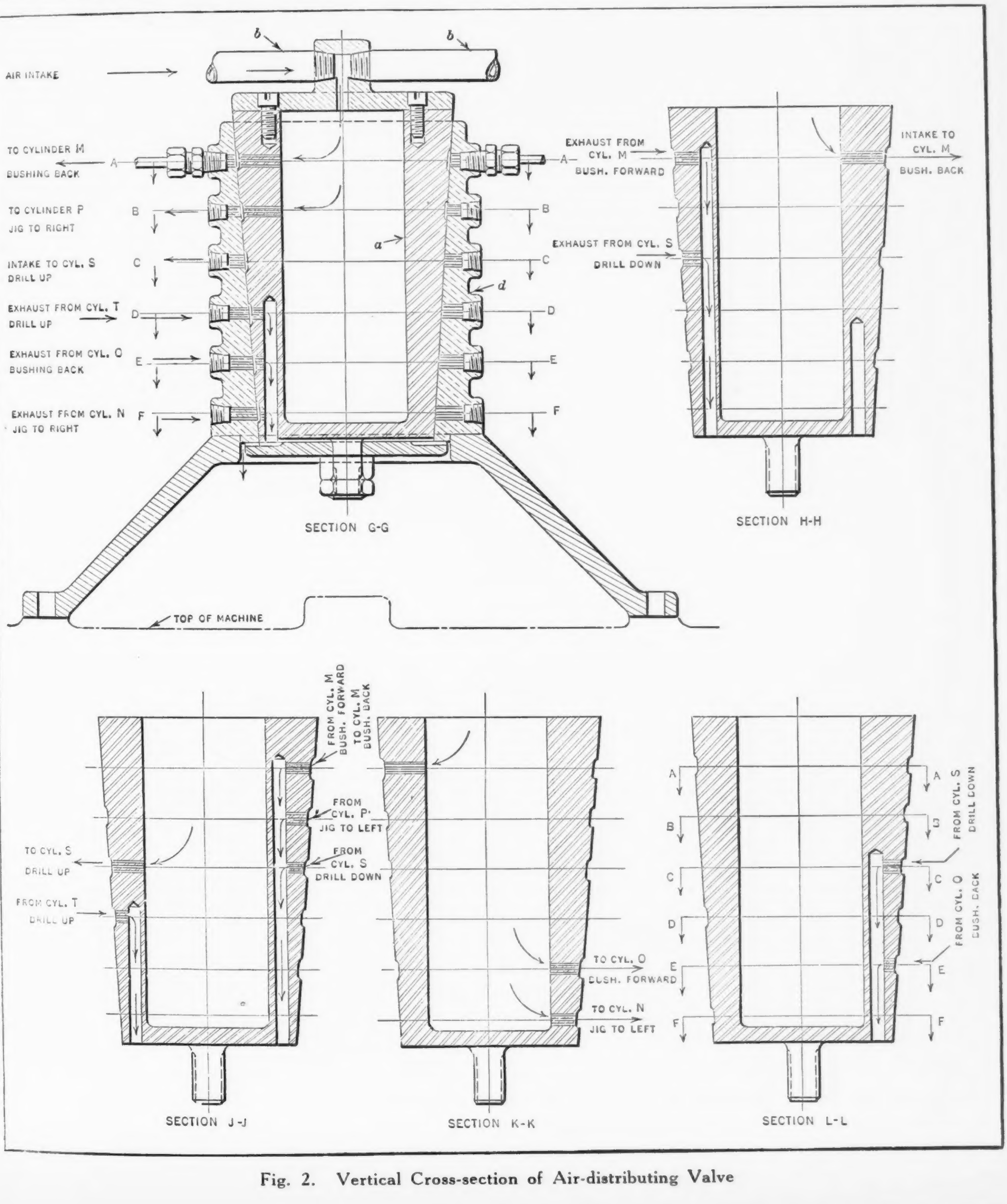


Fig. 2. Vertical Cross-section of Air-distributing Valve

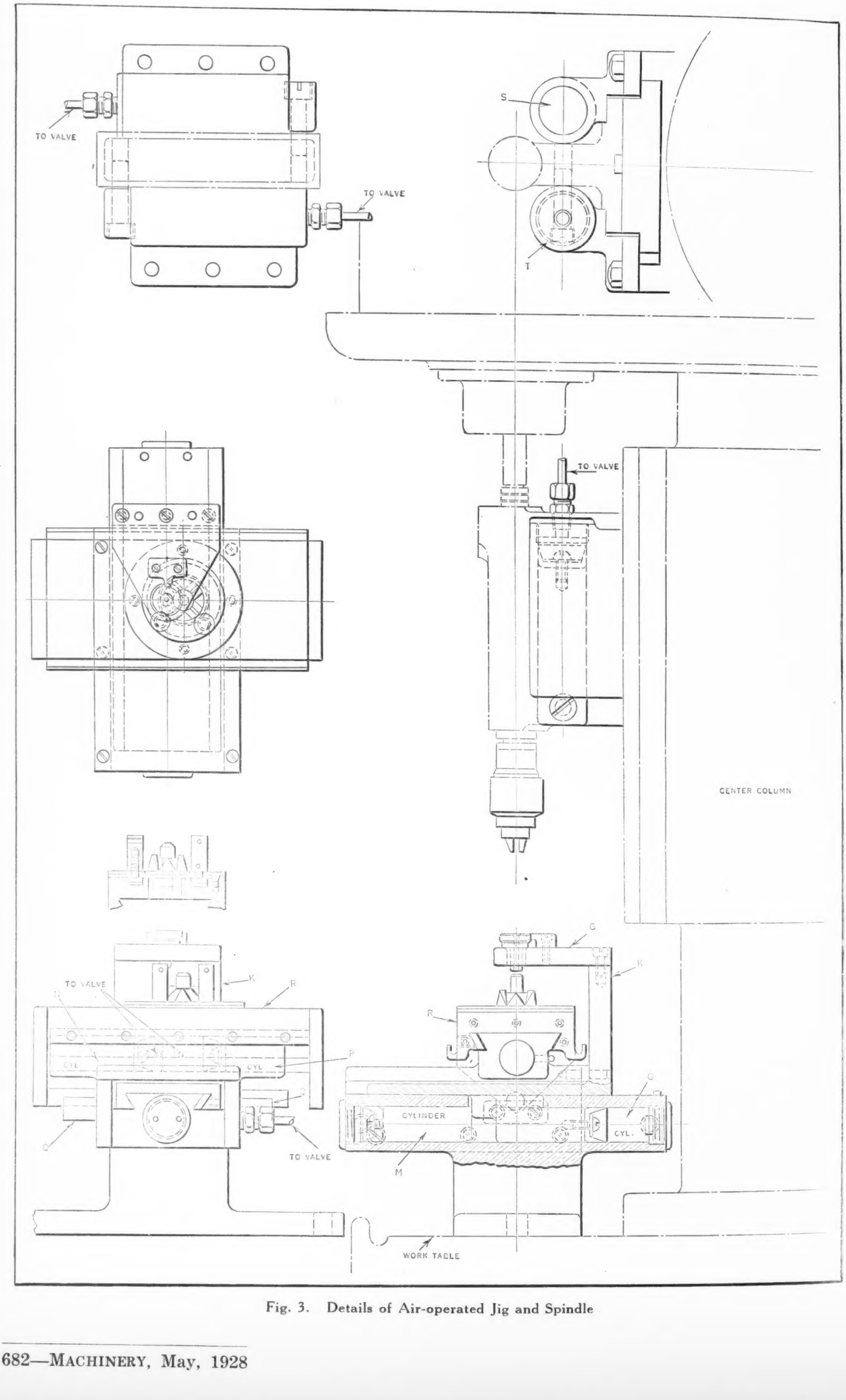


Fig. 3. Details of Air-operated Jig and Spindle

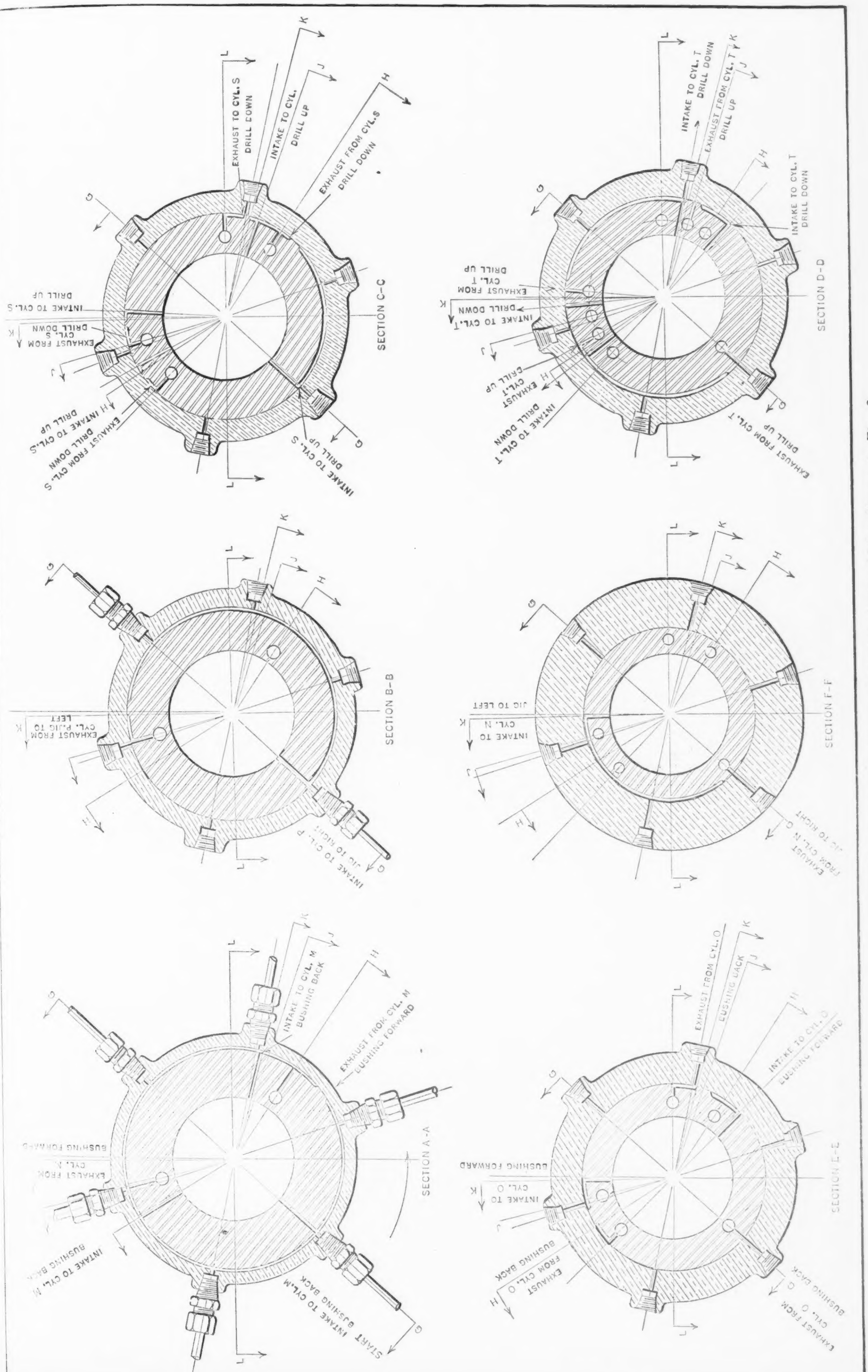


Fig. 4. Horizontal Cross-section Views of Air-distributing Valve Shown in Fig. 2

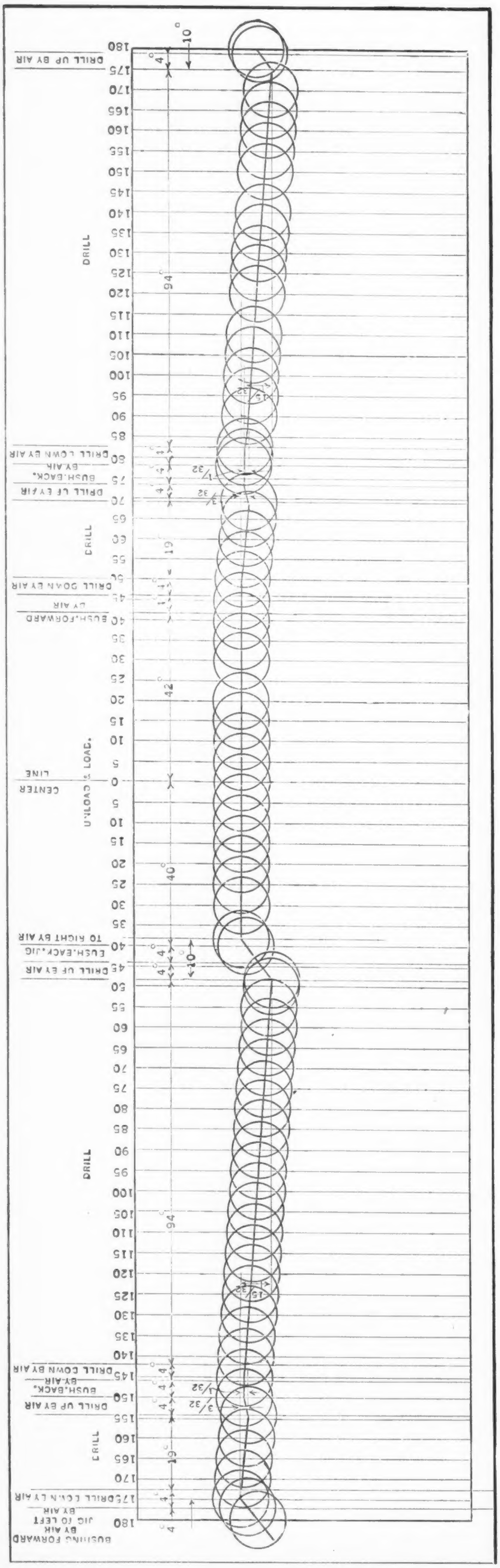


Fig. 5. Development of Feed Cams

by this cam until the hole is drilled to a depth of 3/32 inch. The valve ports that now open admit air to cylinder *S* and permit the air to be exhausted from cylinder *T*, causing the drill to be withdrawn from the jig bushings. The next ports of the valve to open admit air to cylinder *M* and exhaust the air from cylinder *O*, which causes the cross-slide *K* that carries the bushing plate *G* to move the drill bushing back out of the way.

It was found necessary to incorporate the movements described in the two preceding paragraphs to eliminate the drill breakage, caused principally by the drill chips clogging up in the bushings, and to do away with time lost in removing the broken drills from the bushings. This cycle of operations may be repeated as the table revolves, as indicated in Fig. 6.

Unloading and Loading the Jig

When the jig holding the drilled part reaches the loading position, air is admitted to the cylinders *M* and *P*, Fig. 3, and at the same time air is exhausted from the jig cylinders *N* and *O*. This causes the cross-slide *K*, to which the bushing plate *G* is fastened, to recede and the cross-slide *R* to move to the right. The jig is thus brought into a convenient position for unloading and loading. As the table continues to revolve, the cross-slides are returned to the drilling position by means of the cylinders *O* and *P*. The jig under each spindle operates in the same manner, and the operator is kept busy loading and unloading the jigs as they pass his station.

Air-distributing Valve

In Fig. 2 are cross-section views of the air-distributing valve located on top of the revolving table. The inner member *a* remains stationary, and its chamber is connected to the air pressure line. The air pipes *b* prevent the member *a* from revolving with the table. The outer member *d* of the distributing valve is secured to the top of the revolving table, and the pipes from the openings in the sides are connected with the air cylinders which operate the spindles and the jigs.

As the table revolves, holes through the walls of member *a* come into line with holes through the outer member or with channels connecting with these holes, thus permitting air to be distributed to the cylinders as determined by the required cycle of operations. At the left-hand side of the section *G-G*, on the line marked *B*, holes are shown through both members, thus indicating that air is admitted to cylinder *P*, Fig. 3, which causes the jig to move to the right.

It will be noted that there is a hole through the outer member on line *D*, Fig. 2, which is in line with a drilled hole in the inner member, thus permitting air to escape through the base which supports the distributing valve. In this instance, air is being exhausted from cylinder *T*, which causes the spindle at that particular station to be raised so that the drill will clear the jig bushing. The diagram Fig. 6 shows various movements of the spindle and drill jig as it revolves about the central column.

It will be noted that the loading and unloading of a jig must be accomplished while the jig is passing through an arc of 82 degrees. As the table continues to revolve, the part of the jig containing the bushing plate is moved forward while the table revolves through an arc of only 4 degrees. The other movements required to complete the cycle of operations for finishing one part may be easily followed by an inspection of the diagram. The various vertical and horizontal cross-sections of the operating valve in Figs. 2 and 4 show the intake and exhaust ports of the valve and indicate how they are timed to control the operation of the jigs and drill heads, as indicated in the diagram, Fig. 6.

* * *

BASING PRACTICE ON EXPERIENCE

In many instances, methods are determined upon by an analysis of the factors involved, after which what appears to be the best method on paper is selected. This plan is frequently the only one that can be used in arriving at a conclusion, because actual experiments for making comparisons between the methods may be too expensive. Whenever it is possible, however, to make a comparison in a concrete rather than in an abstract form, such a comparison gives far more conclusive evidence.

An interesting example of the latter plan of comparison is furnished by the Ellerman Steamship Lines, which, in order to determine upon the most economical method of marine propulsion for high-speed cargo ships plying between England and the Far East and Australia, are building three vessels, identical in every respect, except that one is driven by reciprocating engines, one by turbines, and one by Diesel engines. In this way, it will be possible to compare, without guesswork, every feature in the operation of the three types of propulsion. This type of experiment is favored in this case by the fact that while these ships are used for conducting an interesting and expensive experiment, they, nevertheless, earn their own way, and are expected not only to pay for the experiment, but to produce a profit as well.

There are many instances when different methods of machining could be advantageously compared in the same manner. If several methods appear to be suitable, no great mistake could be made by installing equipment for each of these methods and noting the results over a period of time. Then when additions to the equipment were required, they could be made from the type of equipment that had given the best results; in so doing, no guesswork would be involved. Actual performance instead of theoretical considerations would be the basis of the selection. Anyone of the methods compared would be likely to be sufficiently satisfactory to produce a profit, so that no direct loss would be incurred in making the experiment.

* * *

CELLULOID RUNNER FOR SLIDE-RULE

By B. R. SHEETS

After the annoyance and expense occasioned by the breakage of several glass slide-rule runners, it occurred to the writer that two pieces cut from an old celluloid triangle would serve in place of the glass runner. Accordingly, the pieces of celluloid were cut to size and accurately drilled. Lines were scribed on these pieces to coincide with the index marks after assembling the slide on the rule.

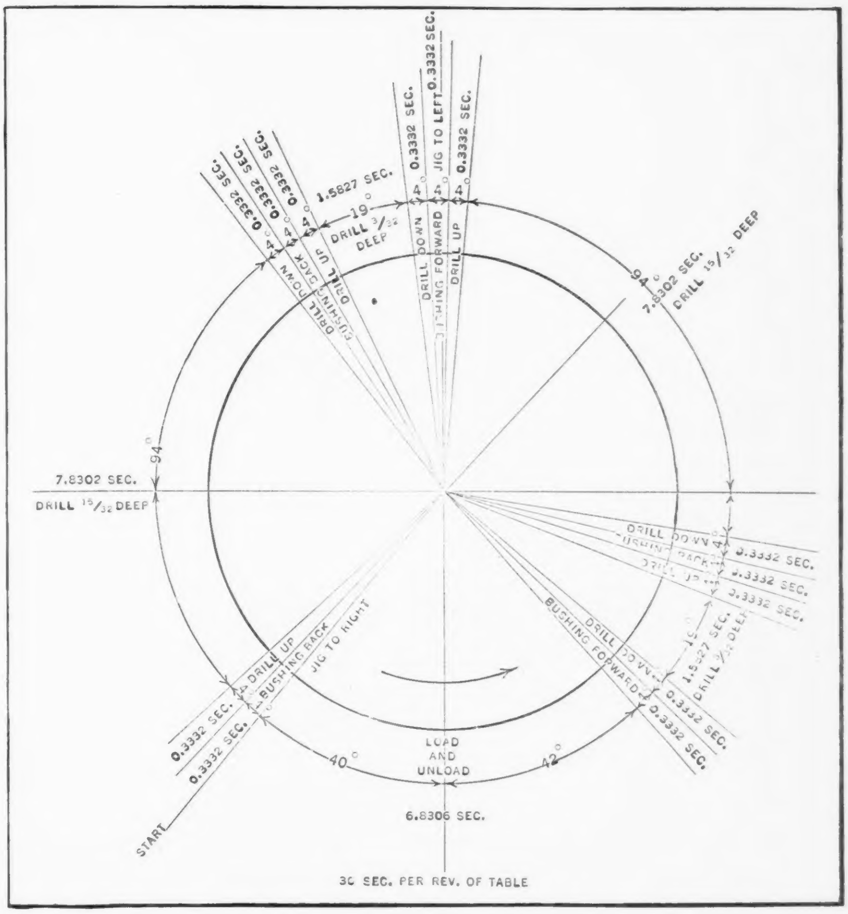


Fig. 6. Diagram Showing Sequence of Jig and Spindle Movements

A rule equipped with a slide like the one described, which has been in constant use for several years, has given excellent service and required no replacements. In this case, the lines were scribed on the outside of the runner pieces, but it would be much better to lay them out accurately on the under side of the celluloid pieces. This brings the lines closer to the graduations on the rule, and makes it easier to take accurate readings. The lines may be laid out from the center of the fastening holes.

* * *

The developments in the aluminum-alloy field have been so great that during the last eight years, according to the United States Bureau of Standards, the tensile strength of aluminum alloys has been doubled, and the elongation has been increased five times.

Modern Methods of Lubrication

By P. K. NIVEN, Dot Lubrication Division, Carr Fastener Co., Cambridge, Mass.
in Collaboration with J. N. Fauver Co., Detroit, Mich.

WHILE there are many industrial plants that have kept pace with modern developments in methods of lubricating machinery, a large number of plants still continue to use old methods of lubrication, which are inefficient and wasteful and have been developed without an appreciation of the requirements to be met. The use of high-pressure lubrication in the industrial field is a step in advance, just as much as the use of high-speed cutting tools and machinery designed to reduce labor cost. Simplicity and dependability of lubrication is just as important as these other improvements, because if the lubrication system fails, the other improvements are of no avail. The selection and standardization of both devices and practices are as essential as the selection of lubricants; in fact, some executives consider this matter even more important.

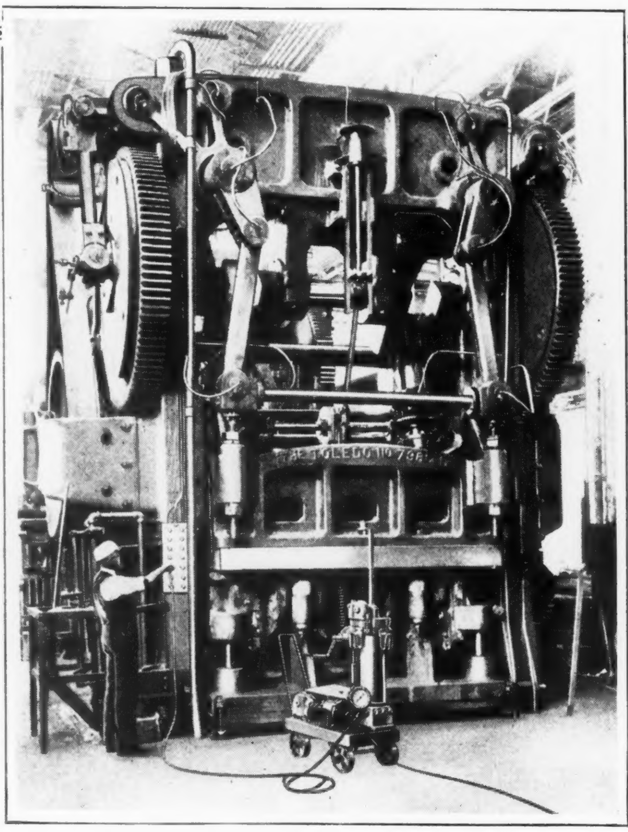


Fig. 1. A Large Press Provided with Centralized Lubrication, Eliminating the Necessity of Filling and Screwing Down Fifty-six Individual Grease Cups

The average industrial plant is confronted with the problem of lubricating a widely diversified line of machines, generally provided with a great number of different methods of applying the lubricant. Lubricating oil containers are frequently open to dust and dirt and are wasteful of oil. Open grease barrels are often scattered throughout the plant for the convenience and easy access of the machine operators. In many plants, however, these practices are being replaced by methods that are based on careful study. The use of the latest equipment results in the scrapping of hit-and-miss methods.

How to Organize for Proper Lubrication

In the following, a general plan is outlined which has proved successful in many large plants. There are three principal points to be considered:

1. Select a system, the principle and construction of which is such that it can be applied advantageously to a large number, if not to all, of the machines in the plant, so as to provide for as great uniformity in the lubrication methods as possible. It is important that all fittings and equipment used in connection with lubrication should not leak and should be dirtproof.

2. The installation of the system selected should be made as complete as possible. There may be machines that do not require high-pressure lubrication; nevertheless, they can be more quickly lubricated with less waste if a uniform system is employed throughout the plant.

3. Take the job of lubricating out of the hands of the machine operator and production foreman and put it into the hands of an experienced machine repair man or millwright, responsible to the maintenance department or superintendent's office.

Capable Man Needed to Attend to Lubrication

The oiling or lubricating of machinery has often been considered a simple job requiring little or no knowledge or skill. Sometimes the important work of oiling the machinery is allotted to the last man hired. It is looked upon as a good job on which to break in a new man. This is a costly way of doing the work.

The operator of the machine should also be relieved, as far as possible, of the work of lubricating, except in the case of a few highly specialized machines. In plants provided with modern methods of machine lubrication, the operator does no lubricating, nor do we find in these plants the faithful employe who has reached old age and cannot do anything else satisfactorily employed in oiling. On the contrary, in plants that have given this subject close study, the best machine repair man available does the lubricating and is held responsible if a machine breaks down because of lack of lubrication. In some high-production plants, maintenance costs have been reduced as much as 50 per cent, by proper attention to the lubrication methods.

Reasons Why Machinery is Not Successfully Lubricated by Operators

It is unwise to add the job of lubrication to the other duties of an operator. His job is to produce work of a given quality in certain quantities, and he should be relieved of any duties not pertaining directly to that job.

Recent surveys show that it is not satisfactory to expect operators to lubricate production machinery for the following reasons:

1. The five or ten minutes taken by the operator to lubricate is that much time taken out of production. Multiply this by the number of operators and the total will be surprising.

2. Machine operators have been known to purposely neglect lubrication in order to avoid stopping their productive work.

3. It does not seem practical to leave a supply of grease cups, oil cups, or fittings with the operator to replace those that may be broken off, damaged, or clogged. On this account, the operator often allows the bearing to go without lubrication rather than take productive time to go to the stockroom to obtain what is required.

4. There is a considerable loss of time in refilling oil-cans or grease buckets from the oil supply.

Examples of What Has Been Accomplished by Modern Lubricating Methods

Fig. 1 shows a large press used in a production plant in Detroit. With the old methods of lubrication, it required the time of two men for one hour each day to climb over the press and fill and screw down fifty-six grease cups. During this period of time the machine had to be stopped. The production value of the press was estimated at $30 per hour, so that, apart from the cost of the lubricant and the wages of the men who filled the grease cups, it cost $30 a day merely to lubricate the press. With the modern system of lubrication, as shown installed on the machine in the illustration, the lubrication is performed in from ten to fifteen minutes while the press is running.

In another instance, at the plant of the Budd Wheel Co. in Detroit, a conveyor with 156 buckets, each having two grease cups, was a constant source of trouble. The grease cups were located so far down between the webs that two fingers could barely be passed in to screw down the cup. The heat and dirt through which the conveyor operated made it practically impossible to screw down these cups except immediately after the grease holes and cups had been freshly cleaned and filled with new grease. It took one man three days to completely lubricate this conveyor. Naturally its lubrication was neglected. With the modern system of lubrication, as now applied, this conveyor is lubricated by one man in five hours while the conveyor is running.

Simplicity and Safety of Lubricating Large Machines

On large machines, the points to be lubricated are often difficult to reach and the oiler has to climb a ladder and reach over into dangerous positions. With modern methods of lubrication, this becomes unnecessary. All the lubrication points are placed within easy reach of a man standing on the floor, and connections to the points to be lubricated are made by means of universal joints and flexible hose.

Five Important Advantages of Modern Lubrication Methods

Through the application of the modern equipment for lubrication now available, five specific advantages are obtained: Safety; the lubrication of bearings while in operation; protection of the lubricant from dirt and dust; prevention of waste; and definitely placed responsibility for lubrication.

Safety is promoted by eliminating the necessity of climbing up ladders, along galleries and on the framework of machinery. The lubrication of bearings while in operation eliminates the losses due to shutting down machinery for long periods of time to give the oiler a chance to do his work. Furthermore, the bearings of all machinery should receive fresh lubricant while in motion. This is the only sure way of completely spreading the lubricant around the bearing. Oils and grease are now kept in closed containers and channels all the way from the storage tanks to the bearings, and in this way they are kept clean and foreign matter is prevented from entering the bearings, causing abrasion and wear.

The proper amount of lubricant is delivered to the bearing under the required pressure. This not only insures adequate lubrication, but also eliminates waste due to excessive amounts of oil and grease being supplied at some periods, while there is a scarcity of lubricant at other times. Finally, the placing of the responsibility for the lubrication on one person insures proper attention to this important factor in the functioning of machines. Breakdowns and bearing troubles are eliminated to a large extent and the resulting savings are very great.

As an evidence of the possible savings, it may be mentioned that one large corporation appropriates $50,000 every three months for continued improve-

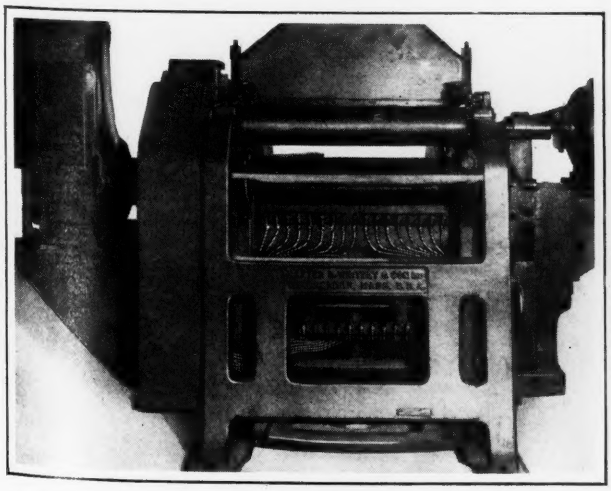


Fig. 2. A Woodworking Machine with Centralized Lubricating System

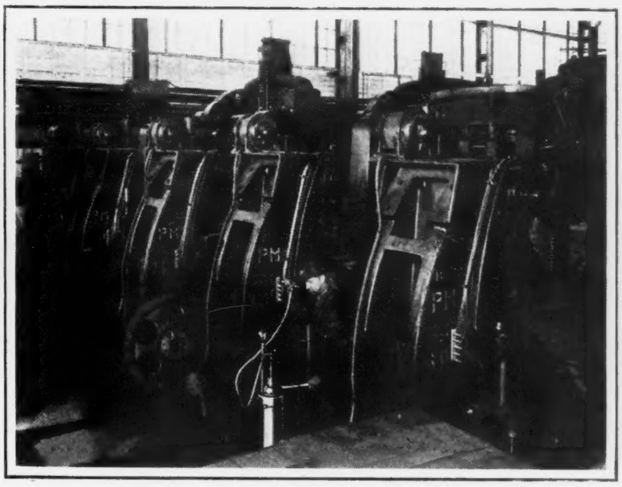


Fig. 3. A Battery of Presses Provided with Centralized Lubrication

ments in the machine lubricating methods throughout the plant. No such sums would be spent were it not evident that proper lubricating methods and devices are a source of considerable savings in plant operation.

It is of interest to note that lubrication equipment manufacturers have recently developed additional service to the industry on lubrication problems. At least one of the manufacturers is in a position to render a complete report relating to the lubrication needs of a plant, covering not only such machines as would be served by the lubrication equipment that he himself manufactures but also the requirements in connection with other manufacturers' equipment. In other words, a complete consulting engineering service is rendered. This is a new departure which is likely to have far-reaching results in bringing about improved methods of lubrication in many industries.

* * *

CRATES FOR MACHINERY AND TOOLS

The methods of constructing crates and boxes for machinery and tools for domestic or export shipment require careful study. High-grade machinery has sometimes been badly damaged because the crates in which it has been shipped have been poorly constructed. The scientific method of making laboratory tests, to determine what kind of crates and boxes are the strongest, can be applied as effectively to this as to more complicated problems.

The Forest Products Laboratory of the United States Government, at Madison, Wis., has conducted experiments for years to determine the most economical way of making crates. In these tests, different kinds of wood have been studied, and in examining joints for wood, thousands of tests have been made on the holding power of nails, screws, bolts, and other means of fastening. In subjecting the crates to the same treatment as they receive in transportation, nothing has been overlooked, and even a vibrating machine, which imitates the swaying motion of a moving freight car and the shocks at the starting and stopping of trains, has been constructed.

It has been found that diagonal braces are the most efficient means of producing rigid crates for shipment. Unless diagonal bracing is used, much larger amounts of material must be employed in making the crate, and a great deal more labor is required. Diagonal braces on all six sides of a crate are recommended. In some instances, this bracing may be supplied by a part of the machine being packed, as for example, when the base of a machine is bolted directly to the crate and the base is strong enough to take care of the stresses to which it is likely to be subjected in transportation.

The blocking and bracing of the machine in the crate is another important point to be considered in packing heavy machinery. Sufficient blocking will not only prevent the machine from shifting, but will also support the weaker parts which are unable to carry the weight thrust upon them when the crate is roughly handled.

The Forest Products Laboratory has tested many crates and boxes for manufacturers, and in almost every instance it has been found that less lumber can be used and the strength of the crate increased by applying some of the simple rules formulated from the results of the tests made.

* * *

Special Tools for Railway Shops

Many special tools are used in locomotive repair shops to reduce the time and labor required for different operations. These special devices, in many instances, also improve the quality of the work. If superintendents and foremen in railway shops could regularly visit the numerous other shops throughout the country, they would be especially interested in these unusual tools and appliances. Since very few shop executives have the opportunity of visiting the repair shops of other railroads in order to obtain new ideas and discuss different methods, a series of articles on special tools for railway shops will begin in June MACHINERY. The information about these unusual and efficient tools and machines has been obtained directly from representative shop superintendents and foremen on different railroads throughout the country.

GERMAN METAL-WORKING INDUSTRY

According to information published by the Department of Commerce, Washington, D. C., the German metal-working machinery industry has a capacity far above the demand, the industry having been developed during the war to great excess capacity. There are now nearly 900 shops in Germany manufacturing metal-working machinery. These, if operating at about 80 per cent of capacity, would be employing 65,000 men. With this equipment, Germany is making about 13 per cent of the world's metal-working machinery.

By way of contrast, the United States is producing 57 per cent of this class of equipment in 400 plants employing approximately 45,000 men. It is interesting to note that in Germany about 1.15 horsepower is provided in these plants per workman, while in the United States 4.4 horsepower per man is used. As a result of having at his command more mechanical power and shops better arranged for production, the American worker produces in an equal period machinery about four times the value of that produced by the German worker.

* * *

AVIATION IN RUSSIA

Considering the vast distances involved in travel in Russia and the comparatively inadequate character of present means of transportation, it seems reasonable to suppose that the development of commercial aviation in that country would be rather rapid and extensive. *Engineering* points out that in 1926, the last year for which complete statistics are available, flights over regular routes totaled over 800,000 miles, and 12,400 passengers were carried. Seven air lines are in regular operation, covering distances varying from 330 to 930 miles. The total length of the regular air routes in the Soviet Union equals 3670 miles. In addition, photographic surveys have been carried out by airplanes of extensive forest areas. A considerable number of the machines in use are of Russian design and construction. It is planned to organize lines that will connect the Soviet Far East and Central Asia with Moscow and Western Europe.

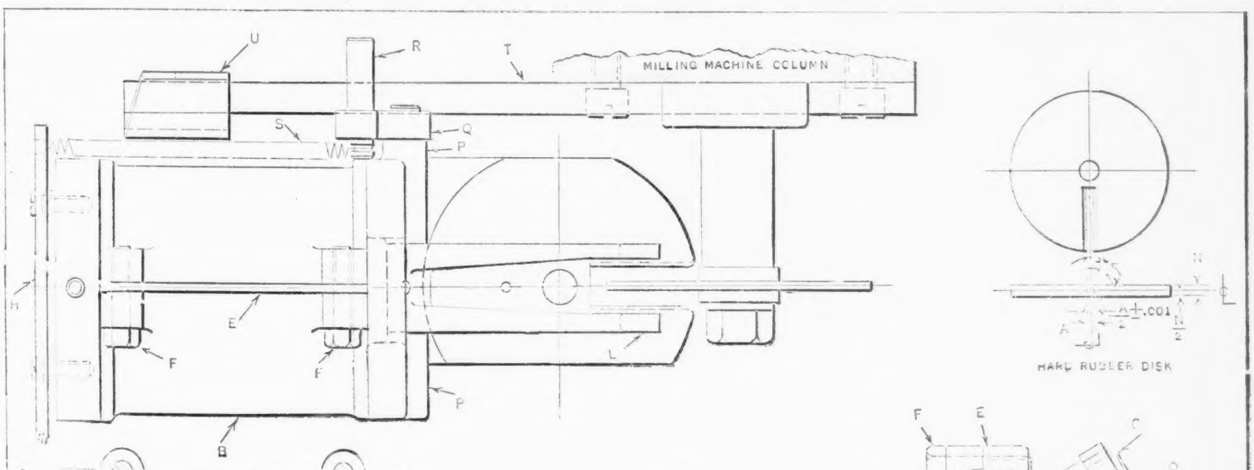
Letters on Practical Subjects

INDEXING AND SLOTTING FIXTURE

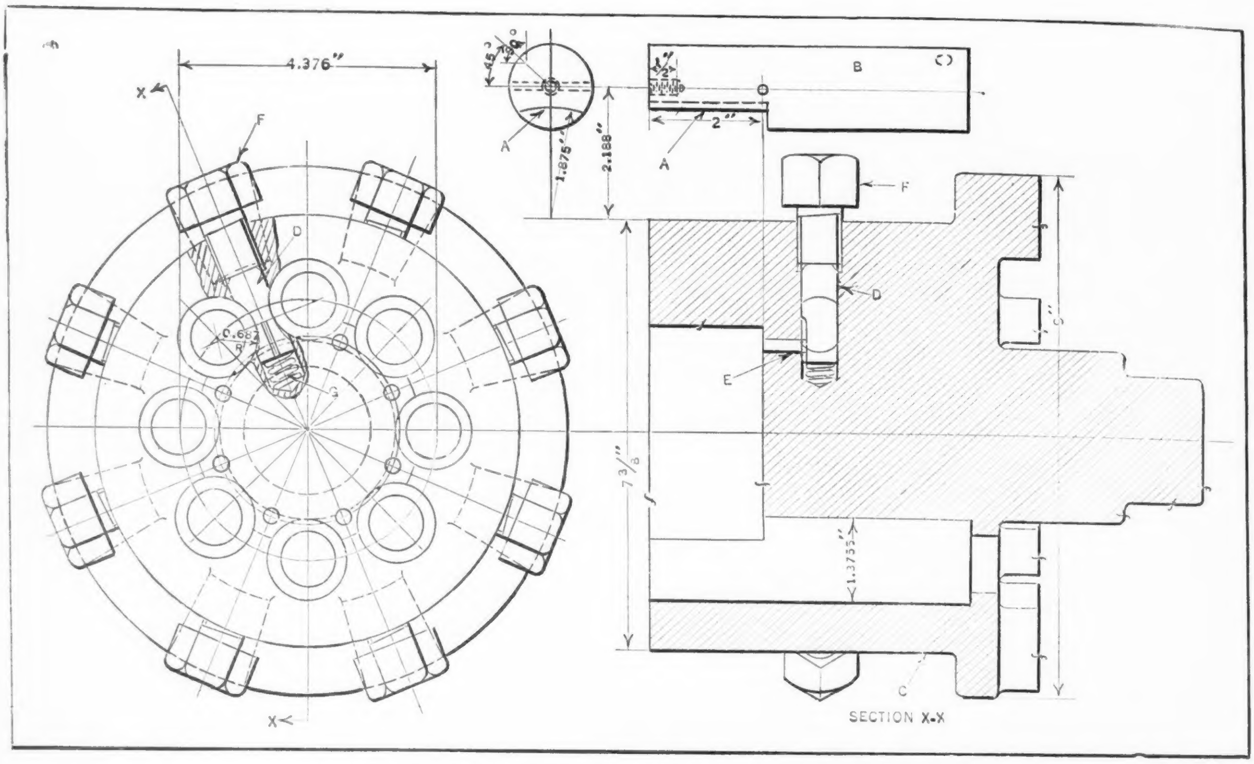
An efficient milling fixture is shown in the accompanying illustration. The job for which the fixture is used consists of slotting a hard rubber disk, as shown in the upper right-hand corner of the illustration. The sides of this slot are to be cut at an angle of 30 degrees with the vertical center line, the angles meeting on the horizontal center line; the opening thus formed must be an exact dimension *A*. The disk is previously machined all over, and a center hole drilled and reamed. These requirements can be met by holding the disk at the proper angles, and taking two cuts with a milling cutter of the correct width *X*, which will give the required opening *A*. How this is accomplished is described in the following.

The fixture base *B* is aligned and clamped on the table of a hand milling machine at one end, as far from the cutter as possible. This base is bored to receive the round shank *C* of the cast-steel bracket *D*. Shank *C* is a snug turning fit in the bored hole. To get proper adjustment for wear on this fit, the bracket bearing in the fixture base is split at the top to admit a shim *E*, the bolts *F* being used to clamp the split bearing against this shim.

A collar *G* bearing against the shoulder on the shank *C* retains the shank in the base, this collar being fastened on the shank by two set-screws. At the end of the shank, outside the collar, a flat bar of steel *H* is screwed to serve as a handle for use in turning the entire bracket *D*. The opposite end of the bracket is machined flat. A hardened and ground plate *J* is secured to this flat face by the hardened and ground shoulder stud *K*, which clamps the plate in position. The distance of the top face of plate *J* from the center line of the fixture is equal to half the thickness of the work, or $N \div 2$. The rubber plate to be slotted is clamped



Indexing and Slotting Fixture for the Milling Machine



Boring Mill Fixture for Radius-boring Ends of Pins

on plate *J*. The head of the stud *K* is an exact fit in the center hole of the disk, thus locating it.

To clamp the disk during the operation, the steel finger *L* is used. This clamping finger is fastened to the cross-shaft *O* which fits a hole in the bosses *P* of the bracket *D*. At the inner end of this shaft is fastened the lever *Q*, the other end of which contains the hardened pin *R* which projects from both sides of the lever. The inner side of this pin is connected to the handle *H* by a stiff spring *S*.

A long steel strip *T* is fastened to the column face of the milling machine and projects outward toward the side where the fixture is mounted. An interference strip *U* is screwed to bar *T* in such a manner as to intercept the pin *R* when the table of the machine is run back. This causes lever *Q* to turn, which rotates shaft *O*, forcing the clamping finger up from the work against the pressure of spring *S*.

In operation, the table of the machine is run back to its limit, so that clamping finger *L* is raised to permit loading and unloading the fixture. When the fixture has been loaded and the table moved forward, the pin *R* leaves the interference strip *U*, thus relieving the pressure of the spring and forcing the clamping finger down on the disk to hold it securely during the operation. The operator now runs the table in toward the cutter, at the same time swinging the bracket *D* by means of handle *H* until the adjustable stop *V* strikes against the stud *W* in the base. This locates the plate at the proper angle for the first cut.

After the first cut, the fixture is brought back until it is clear of the cutter and the bracket *D* is swung over to its second position, when the second adjustable stop *X* strikes the opposite side of stud *W*. The fixture is now brought into position for the second cut, after which it is withdrawn until pin *R* strikes the interference strip *U*, permitting reloading.

New York City — B. J. STERN

FIXTURE FOR RADIUS-BORING PINS

The fixture here illustrated holds eight pins like the one shown at *B* while a 1.875-inch radius is being bored at *A* on one end. The fixture is used on a Bullard boring mill, being centered by means of the round boss which fits the hole in the faceplate, and held in place by clamps. It consists of a base or holder *C* having holes which receive the pins to be machined and suitable means for clamping the work in place. One of the eight work-holding clamps is shown at *D*. Key pins *E* serve to hold the clamping wedges in their proper positions. The clamping screws *F* are used to force the wedges *D* securely against the pins to be radius-bored. The spring *G* forces the clamping wedges back when screw *F* is released.

Rochester, N. Y. — EDWARD T. HEARD

ELECTRIC CONTACT INDICATOR FOR HEIGHT GAGE

The application of Prussian blue to the finger of a height gage to show when it makes contact with the surface to be gaged is a practice that consumes considerable time. The amount of Prussian blue put on also varies considerably with each application. Some workmen use tissue paper as a "feeler" to determine when the finger is in contact with the work. Neither of these methods is as positive as the method described here, which is an adaptation of the electrical contact method used extensively in laboratory and experimental work.

The ordinary vernier height gage having a base to support it in an upright position can be equipped with an electrical contact indicating device in the manner to be described, at a cost of less than $1. No alterations in the height gage are necessary. The simple equipment required consists of some flexible copper wire, two clamps or clips such as are used at the ends of battery wire leads for mak-

ing quick connections with binding posts, an electric buzzer or bell, a 1 1/2-volt dry battery, and a piece of paper of carefully measured thickness, preferably 0.010 inch thick.

Now, the sheet of paper is simply placed under the base of the height gage to insulate it from the surface plate on which the work to be gaged rests. One of the clips attached to a wire leading to one post of the dry battery is clipped to the blade of the height gage. A wire from the other post of the battery leads to one post on the buzzer, and a wire from the other post of the buzzer is connected to the remaining clip, which is attached to any convenient projection on the work.

With this arrangement, it will be evident that the electric circuit will be closed the instant the finger of the height gage makes contact with the work and will cause the buzzer to operate. It is then simply necessary to subtract the thickness of the insulating paper from the micrometer reading to obtain the required measurement. The subtraction is simplified by having a paper measuring exactly 0.010 inch under the base.

An ordinary flashlight socket and bulb can be used in place of a buzzer. The flash of the light will then indicate when contact between the gaging finger and the work is made.

Hartford, Conn. F. EDWARDS

ASSEMBLING TIGHT SCREWS

The writer has occasionally found it necessary to assemble parts in which the screws were too tight a fit when no taps or dies were at hand to resize the threads. This difficulty sometimes occurs when assembling automobile or radio parts, and might happen on a special job in the shop. At such times, it is often possible to overcome the trouble by filing three or four short flutes or notches at the point of one of the screws in such a way that the screw acts as a tap, cleaning the threaded hole and enlarging it slightly when carefully turned in and out.

This works best when steel screws are used for enlarging holes in brass or bakelite, although brass screws can be used for resizing holes in bakelite or fiber. If both parts are of soft steel, one or two small notches at the point of the screw will clean dirt or chips out of the thread in much the same way as a notched thread gage, but a soft steel screw cannot be expected to retap soft steel. If the trouble occurs on a special job in the shop, the notched or fluted screw can, of course, be hardened sufficiently to do the job. Lubrication helps in assembling, but not when doing the resizing.

Farmington, Conn. ERNEST L. HOLCOMB

SLOT AND TONGUE MEASURING GAGE FOR USE WITH MICROMETER

The accompanying illustrations show a tool designed by the writer for taking small accurate measurements in places not readily accessible. It consists essentially of a flanged plunger *A*, Fig. 1, which slides in the flanged barrel *B*, the adjusting movement being secured by the screw *C*. The cross-section of the assembled tool is shown in the lower left-hand corner of the illustration. The dimensions given merely serve as a guide, and need not be followed in making a gage of this kind.

The plunger *A* is made a tight sliding fit in the barrel *B*. The bore of the plunger is threaded to give a tight fit on screw *C*, a fine thread being used to facilitate making close adjustments. The flanges on both plunger *A* and barrel *B* are made 0.100 inch thick, so that the smallest groove into which they will enter is 0.200 inch wide. Plunger *A* is provided with a keyway which is engaged by the small end of screw *E*, and is thus prevented from turning with screw *C*.

The knurled knob *D* is pinned to the end of screw *C*, being carefully positioned to prevent any

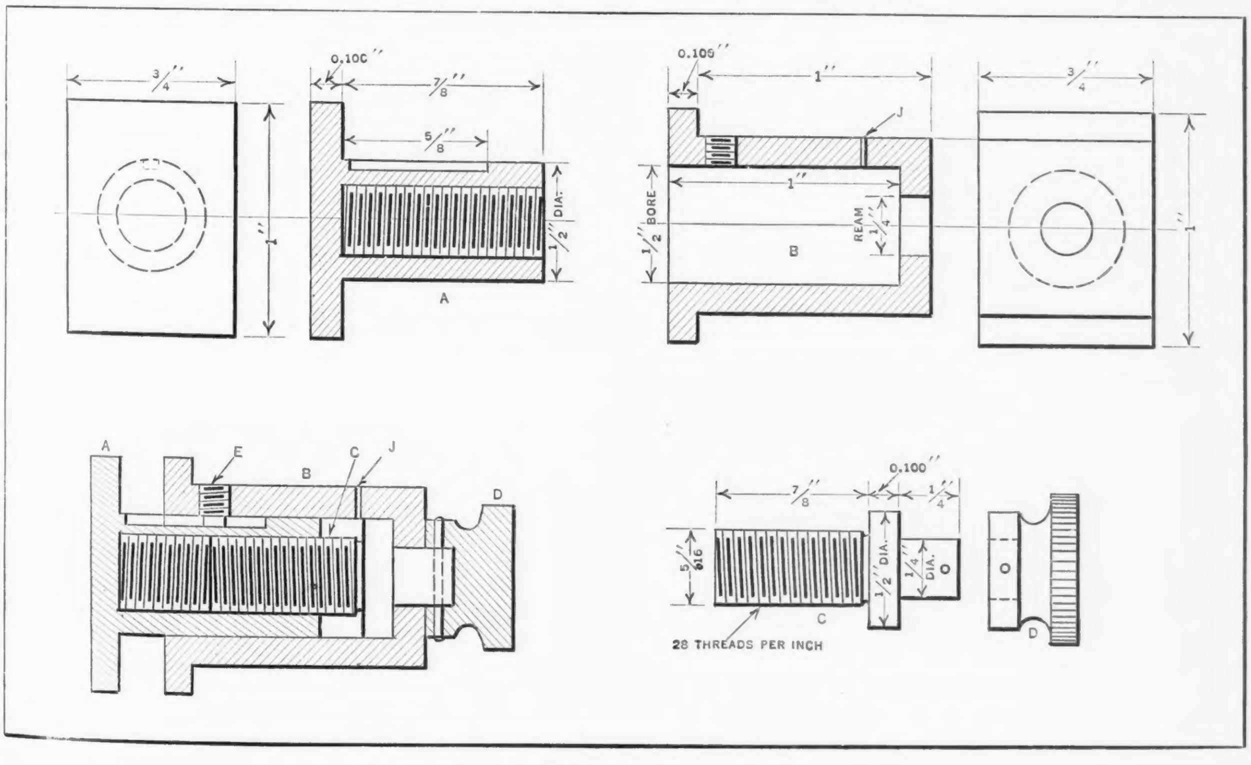


Fig. 1. Details of Gage for Use with Micrometer

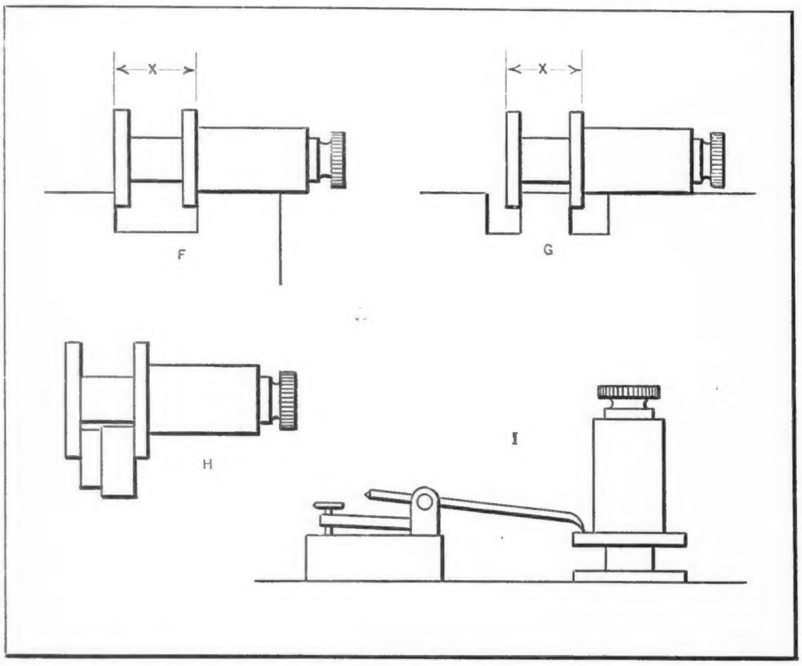


Fig. 2. Method of Using Gage Shown in Fig. 1

end play of screw *C* in barrel *B*. It will be noted that the keyway in plunger *A* does not extend the full length of the plunger, and hence the latter member is retained in barrel *B* and prevented from being extended far enough to spring the gage when the flanges are brought into contact with the work. Barrel *B* is provided with a small hole *J*, which permits air to escape when plunger *A* is moved inward and also provides for lubricating the screw *C*.

A few methods of using the tools are illustrated in Fig. 2. When the flanges are brought in contact with the sides of a groove, as shown at *F*, the measurement *X* taken with a micrometer is equal to the width of the groove. At *G* is shown the method of measuring the thickness of a wall or tongue located between the two grooves. The thickness of the wall, in this case, is indicated by the measurement *X* minus the thickness of the two flanges. The method of using the tool as a snap gage is shown at *H*, the flanges on one side being clamped between spacing blocks, while the flanges on the opposite side are being used to gage the work. At *I* is shown the tool being used for setting a surface gage.

Philadelphia, Pa. R. H. KASPER

FASTENING ENDS OF COIL STOCK

When one has frequent occasion to use such material as spring steel, strip brass in coils, etc., the need of some method for fastening the ends quickly and easily soon becomes apparent. The writer has found a short strip of ribbon or wire solder to be so well adapted for this purpose that he believes that others will benefit from its use. The ribbon or wire solder holds the material securely, and can be easily and quickly applied or removed.

New York MALCOLM KINGSLEY PARKHURST

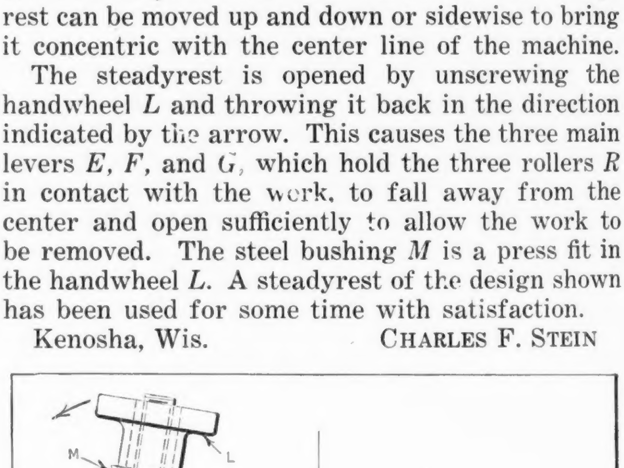
NARROW EQUALIZING STEADYREST

A narrow steadyrest of the equalizing type, designed for supporting the center bearing of an automobile crankshaft, is shown in the accompanying illustration. The crankshafts for which the steadyrest is used vary in size from 0.010 inch under the standard dimensions to 0.010 inch over. A series of levers and rollers held between two 1/4-inch plates fastened to the base which is fitted to the ways of the machine constitute the rest. The illustration shows the steadyrest in the closed position. The levers are held in place by the three main pins *A*, *B*, and *C*, which, in turn, are separated by the two side plates, one of which is shown at *D*. Small flat-head screws in each end of the pins serve to hold them in place. The pins must be equally spaced on a circle concentric with the center line of the work.

The main levers *E*, *F*, and *G* are linked together by parts *H*, *I*, *J*, and *K*. Links *I* and *J* actually function as one link being made in two parts to provide for adjustment when fastening the steadyrest to the machine. With this adjustment, the center line of the steadyrest can be moved up and down or sidewise to bring it concentric with the center line of the machine.

The steadyrest is opened by unscrewing the handwheel *L* and throwing it back in the direction indicated by the arrow. This causes the three main levers *E*, *F*, and *G*, which hold the three rollers *R* in contact with the work, to fall away from the center and open sufficiently to allow the work to be removed. The steel bushing *M* is a press fit in the handwheel *L*. A steadyrest of the design shown has been used for some time with satisfaction.

Kenosha, Wis. CHARLES F. STEIN



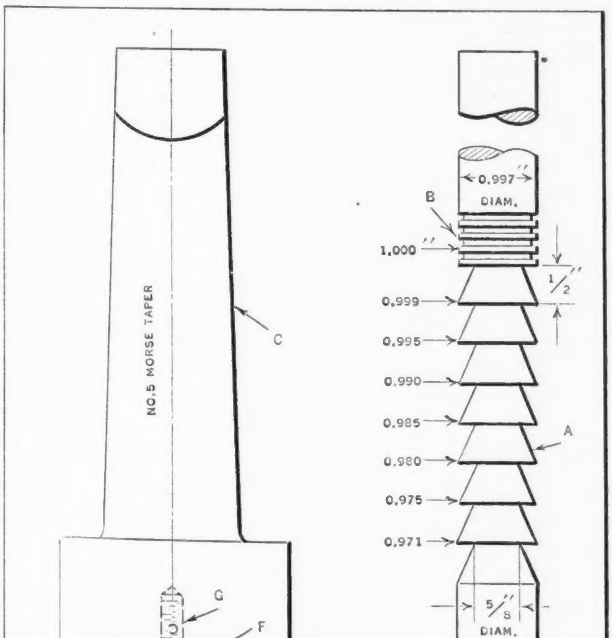
Equalizing Steadyrest for Crankshaft

COMBINATION BROACH AND BURNISHING TOOL

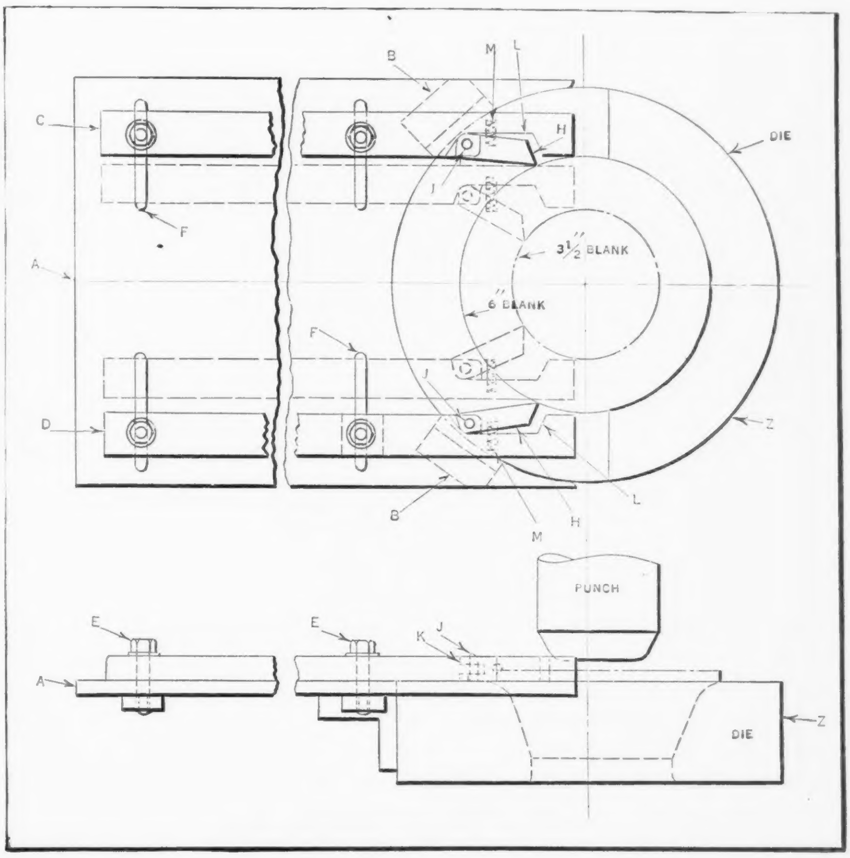
The combination broach and burnishing tool and the driving shank for the broach, shown in the accompanying illustration, are employed on a drill press. The holes finished by this tool are required to be very accurate in size and roundness. A high finish is also required. The cutting teeth *A* of the broach are of ordinary design, but immediately following the last cutting tooth are four burnishing rings *B*. These rings are 1/8 inch wide, and are accurately finished to a diameter of 1.000 inch.

The holder or driver has a shank *C* which fits the taper in the drilling machine spindle. The lower end of the shank is counterbored to receive a ball thrust bearing *F*. The adapter piece *H* is also counterbored to fit the thrust bearing. The screw *G* serves to retain the adapter in place. This adapter permits the drilling machine power feed to be employed in forcing the broach through the work without causing it to rotate with the spindle. Very good results were obtained by the writer with a broach of this kind, made from Diamond brand chrome-nickel steel, which is oil-hardened. With a steel of this kind, no trouble was experienced from warpage.

Philadelphia, Pa. F. SELL



Driving Shank and Combination Broaching and Burnishing Tool



Die Equipped with Blank-holding Device

BLANK-HOLDING DEVICE FOR DEEP DRAWING DIE

A device for guiding and holding the blanks fed into a deep drawing die is shown in the accompanying illustration. The die member *Z* is interchangeable in its housing on the press, several sizes being made up to suit requirements, ranging from 3 1/2 to 6 inches in diameter. The stock drawn by these dies ranges from 3/16 to 7/16 inch thick.

The plate *A* forms the base of the guide, being held level with the face of the die by the angle pieces *B*. Two side strips *C* and *D*, which rest on plate *A*, form the side guides for the blanks. Bolts *E*, extending through slots *F*, clamp these side pieces in position on plate *A*. The slots in the guides are of sufficient length to permit adjusting the guides to suit the various blank sizes. After the guides are set, the blanks are fed to the die, one blank pushing the one just ahead of it along until it is stopped directly under the forming punch by a half-round locating nest on the die.

With this arrangement, it was found that the descending punch, on striking the blank, would cause it to jump backward about 1/16 inch, thereby resulting in an unevenly drawn shell. This fault was corrected by introducing two hardened steel fingers *H* on the side strips, as shown in the illustration. The hardened fingers are pivoted on pins *J*, slots cut in the ends of the fingers being fitted over the tongues *K* cut in the plates *C* and *D*. The plates are also relieved at *L* to allow sufficient clearance for the fingers *H*.

The fingers are backed up by springs *M* as shown, which causes them to press against the periphery of the blank and prevent it from jumping back out of contact with the locating nest. The positions

of the guides for the smallest size blank are indicated by the dotted lines, while the full lines show the guides in position for the largest size blanks.

New York City — B. J. STERN

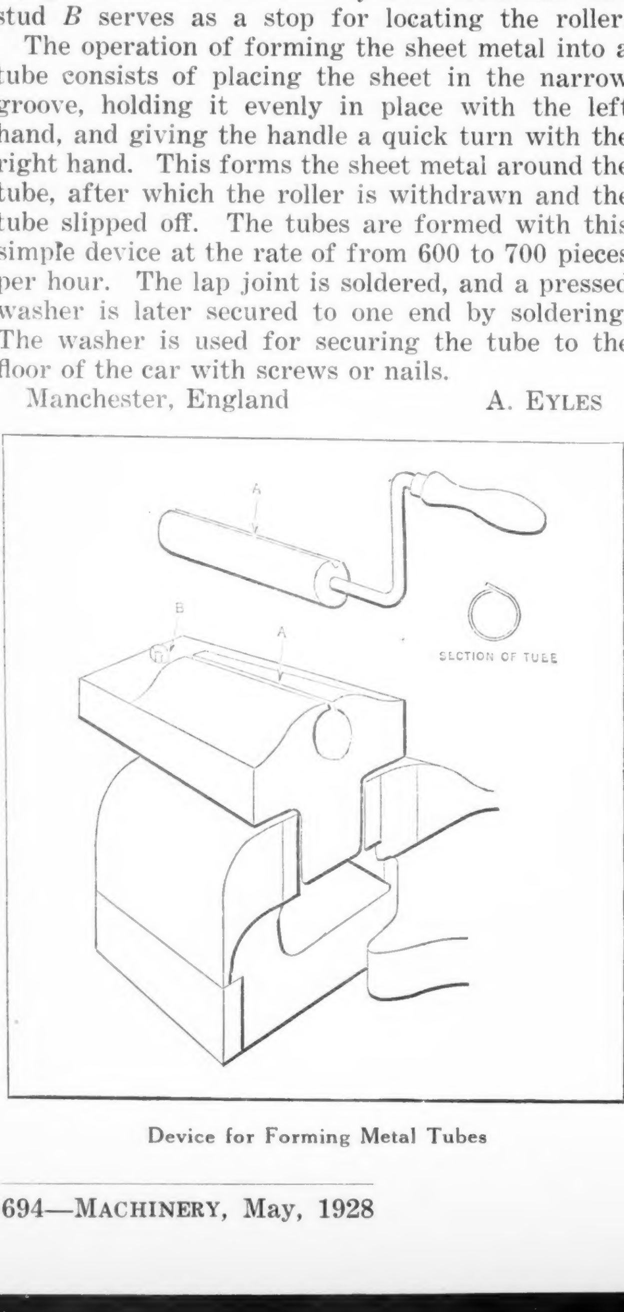
HAND-OPERATED TUBE FORMER

The simple device shown in the accompanying illustration was recently made for use in forming a large number of small sheet-metal cylindrical tubes with lap joints. Although the shop where the device is used is well equipped with forming machines adapted for general sheet-metal work, none of the machines was suited for forming small-diameter tubes. The tubes serve as inlet ventilators, and are fixed in railroad passenger car floors, being used in connection with the steam heating apparatus. The stock used for the cylinders is No. 26 (0.0181 inch thick) lead-coated sheet steel, which is cut into pieces 2 1/2 by 4 1/4 inches. The formed tubes are 3/4 inch in diameter by 4 1/4 inches long.

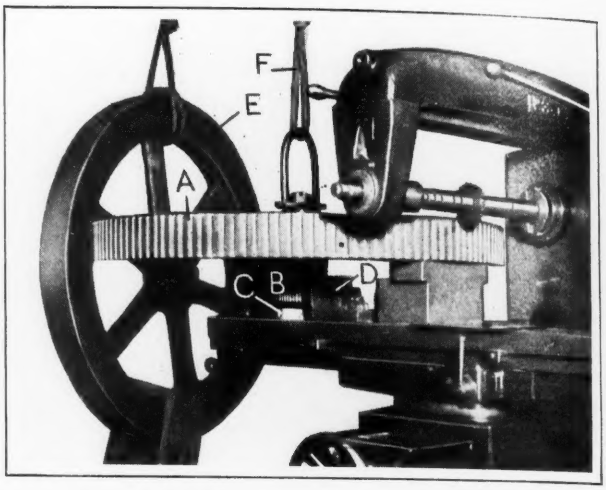
The tube-forming device is clamped in a bench vise. It consists of a cast-iron body and a steel roller with a handle attached. The steel roller is 23/32 inch in diameter, and has a narrow groove cut along one side, as shown at *A*. The metal part of the handle is oxy-acetylene welded to the roller and provided with an ordinary wooden handle. The stud *B* serves as a stop for locating the roller.

The operation of forming the sheet metal into a tube consists of placing the sheet in the narrow groove, holding it evenly in place with the left hand, and giving the handle a quick turn with the right hand. This forms the sheet metal around the tube, after which the roller is withdrawn and the tube slipped off. The tubes are formed with this simple device at the rate of from 600 to 700 pieces per hour. The lap joint is soldered, and a pressed washer is later secured to one end by soldering. The washer is used for securing the tube to the floor of the car with screws or nails.

Manchester, England — A. EYLES



Device for Forming Metal Tubes



Cutting Teeth of a Large Gear on a Small Milling Machine

CUTTING A LARGE GEAR ON A SMALL MACHINE

In the accompanying illustration is shown a cast-iron gear *A* weighing 600 pounds, mounted on a small universal milling machine in the position in which the teeth were cut. The gear is 45 2/3 inches in diameter and has 135 teeth of 3 diametral pitch. The gear blank was formerly one of two flywheels of a large belt-driven punching and shearing machine. This machine was to be converted into a motor-driven shear. In applying the motor drive, it was necessary to cut teeth in one of the flywheels.

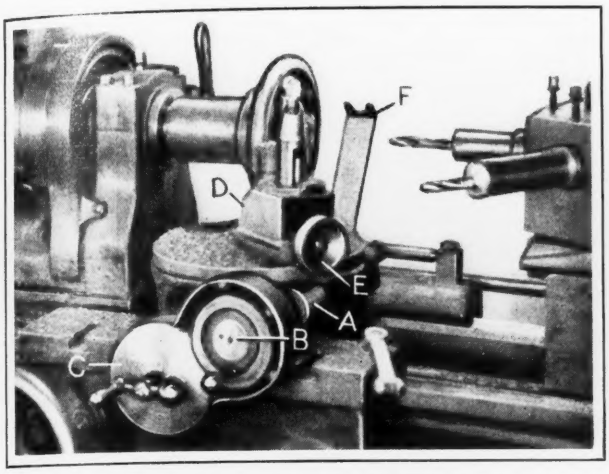
As the flywheel or gear blank was too large and heavy to be supported by the milling machine table, it was counterbalanced by the other flywheel *E*, of the shearing machine, which was made to serve as a counterweight. A 1/2-inch steel wire cable *F* attached to pulley *E* and running over two rope pulleys mounted on a 6- by 8-inch overhead timber, was attached to the work as shown.

The impossibility of using the regular dividing head in cutting a gear of this size made it necessary to devise another method of indexing and supporting the work. The first step was to cut a 10-pitch master gear *B* and key it to a steel sleeve on which the gear *A* was mounted. The sleeve with the gear blank and master gear mounted in place was then placed on the flanged stud *C* which was securely bolted to the milling machine table.

An adjustable locking or indexing device was also fastened to the table. The body of the locking device consisted of a heavy angle-shaped piece of steel 2 by 6 by 6 inches. This body was fitted with an adjustable indexing latch having four or five teeth which were exactly the same shape and pitch as the teeth in the master gear. The angle-piece was fastened securely to the milling machine table with just enough clearance between the master gear and angle-piece to permit adjusting the indexing latch.

The latch was set or pressed into mesh with the teeth of the master gear by means of two set-screws. These set-screws were set up after each indexing movement which followed the cutting of a tooth space. The hole in the sleeve on which the gear blank and master gear are keyed was made a good turning fit on the flanged stud *C* so that the master gear and work could be readily indexed.

Chattanooga, Tenn. — H. H. HENSON



Set-up for Turning Handwheel Rim

TURNING HANDWHEELS

There are a number of ways in which handwheel rims may be finished. In some shops, they are ground, while in others, they are finished by turning. The equipment used in turning the rims of handwheels in a plant manufacturing lathes is shown in the accompanying illustration. As will be observed, a special turntable is mounted on the cross-slide of a turret lathe. The bottom of the turntable has worm-gear teeth cut around its outer edge into which a worm is meshed at point *A*. This worm is on the same shaft as spur gear *B*, which meshes with gear *C* on the regular cross-slide screw, so that by throwing in the regular cross-feed the turntable will be rotated.

The regular nut on the cross-feed screw is, of course, not used under the turntable, thus leaving the screw free to turn without distorting the cross-slide setting. The turntable carries tool-block *D* which may be adjusted to or from the center of rotation by means of the small handwheel *E*. A gage *F* is mounted on a trunnion at the back of the carriage. This gage is used to set the carriage so that the center of rotation will be in line with the middle of the handwheel rim. To permit this to be done, the gage is dropped forward on the handwheel and the carriage moved so that the notch in the gage rests over the rim of the handwheel. The carriage is then located on the lathe ways, and does not need to be set again as long as the same type of wheel is being turned. After the carriage is set, the gage is swung back out of the way.

The handwheel is held in a sleeve chuck screwed to the lathe spindle nose. This chuck has a recess at its outer end which receives the hub of the handwheel. There are also four hooked driving projections, each of which engages an arm of the handwheel. The handwheel is merely slipped into place and moved around so that the arms will rest securely behind the projecting drivers. The center hole in the hub of the handwheel is made by a drill held in the turret, which operates while the rim is being turned. This reduces the total machining time, and the drill helps to hold the work solidly in the driving chuck. Boring, reaming, and facing tools are also mounted in the turret, so that all the machining operations may be performed at one setting of the work.

Cleveland, Ohio AVERY E. GRANVILLE

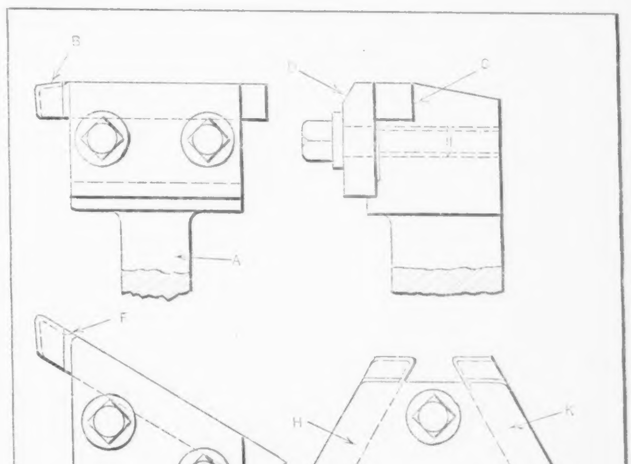
CONVENIENT HOLDERS FOR STANDARD-SECTION TOOL BITS

When using the larger variety of turret lathe for medium sized and light work, and when work is passing through the factory in small lots of many different kinds, it is sometimes difficult for the man who sets up a turret lathe to adapt tools to a job without making up a number of special forms. For such cases and when the work is made of brass or light material of various kinds, the holders shown in the accompanying illustration will be found to be a convenience, and are inexpensive to construct.

They can be easily made to take standard 5/16, 3/8, or 1/2-inch square high-speed steel tool bits, according to the requirements of the work. The body of the tool-holder can be made from a machine-steel forging or it can be milled out from a rectangular bar of steel. In the example *A*, the tool *B* is useful for facing cuts, but is not suitable to face up to a shoulder. The body of the tool is machined out to receive the tool at *C*, and the clamp *D* holds it firmly in position. In action, it is almost like a solid tool, but, of course, it has not the heat-resisting properties of a tool having greater section.

In the example shown at *E*, the tool *F* is set at an angle so that shoulder work can be done with it very easily. The general construction is like that previously described. In the other example *G*, two tools are set at an angle of 30 degrees to the center line, at *H* and *K*. In cases where it is necessary to straddle a flange and face both sides of it, a tool constructed along these lines has possibilities limited only by the distance between the tool bits and the amount of adjustment that can be obtained. In one factory with which the writer is familiar, a great many of these tools are in constant use both in the turret lathe and engine lathe department, and they have proved to be most economical in the matter of upkeep as well as time-saving qualities.

A. A. D.



Tool-holders for Standard Tool Bits

GRIPPING TEST SPECIMENS IN TENSILE TESTING MACHINE

Holding large tubing, bars, etc., in the testing machine for determining the tensile strength often presents a difficult problem. A way in which tubing has been gripped successfully is shown in the accompanying illustrations.

In the assembly view, Fig. 1, are shown T-shaped plates *A*, which are gripped by the regular jaws of the testing machine. The T-plates have four holes drilled and tapped in them, one at each corner, for the bolts *B* which hold the gripping vises *C*, shown in detail in Fig. 2. These vises have four adjustable jaws *D*, placed at an angle of 90 degrees to each other and fitted with lock-nuts *E*. Because the jaws are adjustable, various sizes of test specimens can be gripped.

The heads of the gripping jaws have teeth cut on them similar to those on the jaws of the machine. The sectional view, Fig. 3, shows how these jaws are constructed. Flat-head special bolts *F* serve as axes for the gripping head and allow the heads to remain stationary while the spindles are turned. The spindles *G* are threaded into the block of the vise and are equipped with floating heads *J*, which are made in two parts. The outer part, in which the gripping teeth are cut, slides on the inner part on an inclined surface. In testing tubing, a steel plug *H*, Fig. 1, is placed inside the tube to prevent it from being crushed when it is compressed by the jaws of the vise.

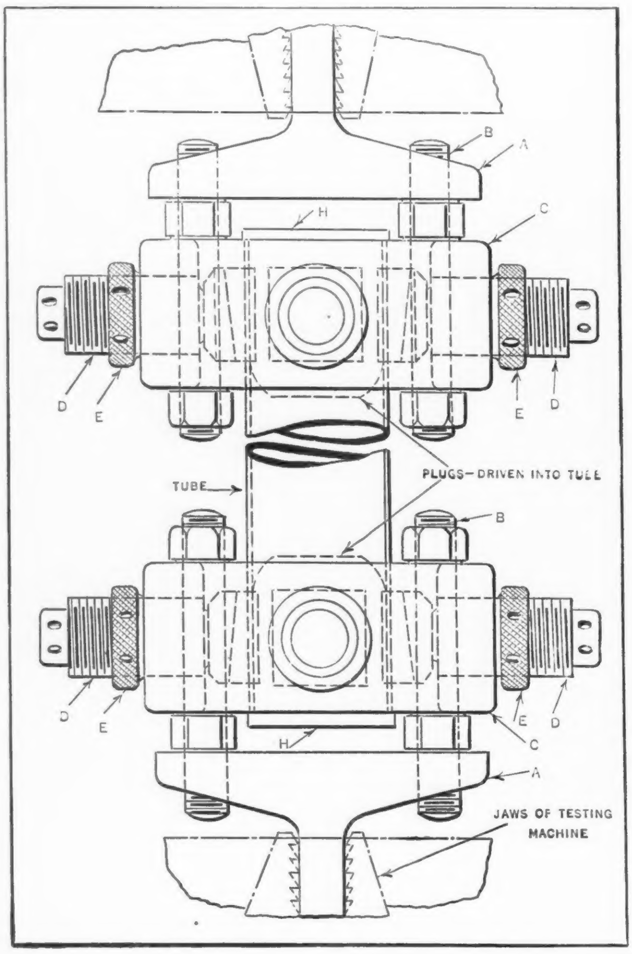


Fig. 1. Jaws for Holding Large Pipe in Testing Machine

After inserting the tube with the plug inside it between the jaws of the vise, the required gripping tension is applied by turning the spindles *D*, Fig. 1. When the spindles are thoroughly tightened, they are locked by the lock-nuts *E*. Tension is then applied to the specimen. If any slipping occurs, it must take place between the two sections of the gripping jaw heads, along the inclined surfaces. Note in Fig 1 that these surfaces in both the vises are inclined in opposite directions, so that the movement of the inner parts of the jaw heads away from each other will tighten the outer parts against the specimen being tested.

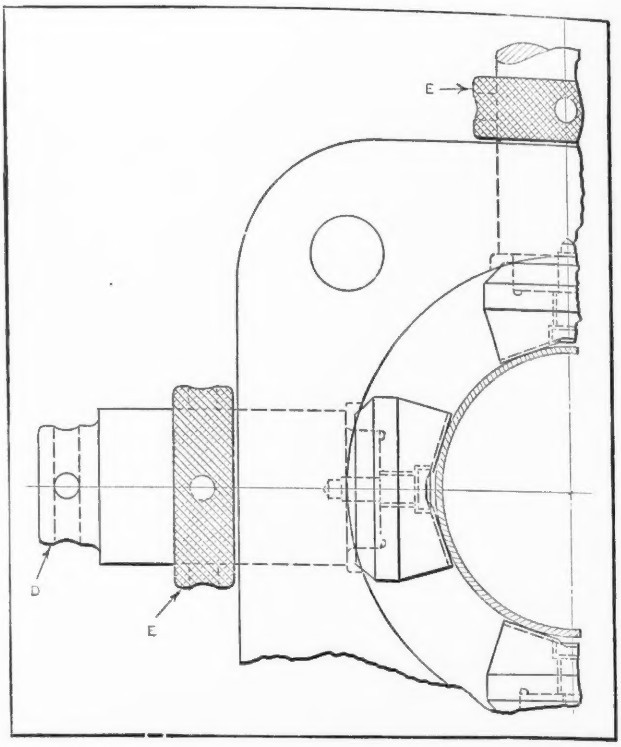


Fig. 2. Detail View Showing Construction of Jaws

Philadelphia, Pa. PETER HAGEN

* * *

In a recent issue of ***Oxy-Acetylene Tips*** it is suggested that when pulleys work loose on shafts and it is found that the keyways are badly worn, considerable machine work can be avoided by using the following method developed in a machine shop in California: The end of an over-size key is tipped with stellite, and the corners are then ground sharp. When the key is driven into place, the stellite end does whatever cutting is necessary in order to seat the key securely.

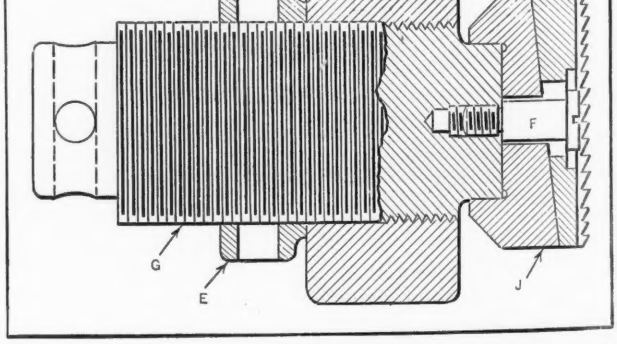
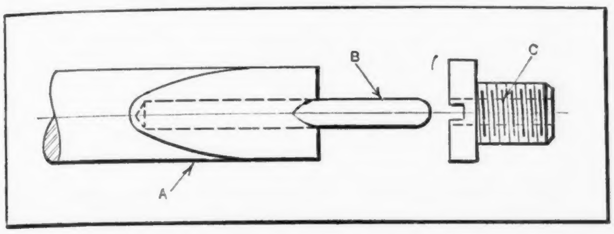


Fig. 3. Section of Special Jaw for Testing Machine Vise

Shop and Drafting-room Kinks

SCREWDRIVERS FOR USE IN INACCESSIBLE PLACES

The accompanying illustration shows the end of a screwdriver *A* fitted with a pilot *B* for inserting small screws in inaccessible places. It will be evi-



Screwdriver End Equipped with Pilot for Holding Screw

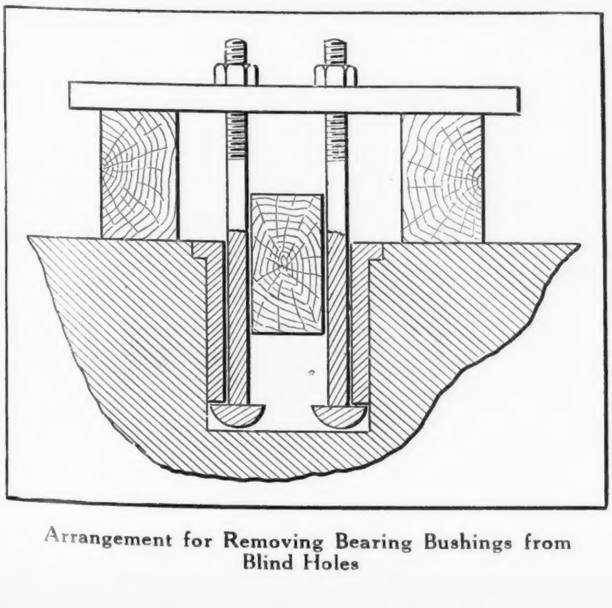
dent from the illustration that the screws, which are made with a hole running through their centers, as shown at *C*, are first placed on the pilot of the screwdriver and then screwed into place. This method of facilitating the insertion of small screws can be applied to a wide range of work.

Rochester, N. Y. ERNEST C. ALLEN

REMOVING TIGHT BEARINGS

Occasionally "blind bearings" are found in some machine parts, such as electric motor end brackets, and the removal of the bushing presents a real problem. The illustration shows a method used successfully in our repair shop for this work.

Two carriage bolts are placed inside the bushing with their heads fitting underneath it. A wooden wedge is driven between these bolts to hold them in place, and a steel strap, through which the two bolts project, straddles two wooden blocks of suitable height. Alternately tightening first one nut and then the other, exerts sufficient pull to draw almost any bushing. Some bushings extend all the way to the bottom of a blind hole and prevent hooking the bolt heads underneath. This, however, is seldom the case. Before replacing such a bush-



Arrangement for Removing Bearing Bushings from Blind Holes

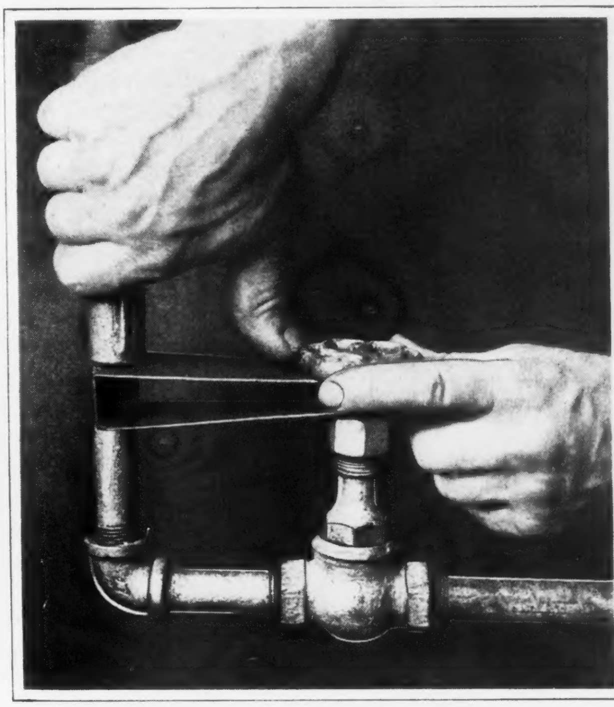
ing, we always cut off a little from the end or grind an offset in it to facilitate subsequent removals.

This arrangement is so successful and quickly assembled that we often use it on other types of bearings in preference to the standard types of bearing pullers.

Columbus, Ohio DAVID WILLIAMS

TWO HANDS REQUIRED TO OPERATE VALVE

Two valves connected to a mixing tank happened to be so placed that operators found it convenient, in a hurry, to open them both at the same time. Better mixing results could be obtained, however, if the valves were opened separately. As warnings



Valve that Requires Two Hands to Operate it

were ineffective, the device shown in the accompanying illustration was installed, so that the valve could be operated only by using both hands. This is a piece of flat spring steel, bent double and cut out at the back to fit the vertical pipe. A hole is drilled through the front ends to clear the valve spindle, and the top end is upturned so that it fits in between the spokes of the wheel. It is impossible to operate this valve until the spring is pressed down so that the upturned end is clear of the wheel.

Hamilton, Ont., Can. H. MOORE

* * *

Of the 180 companies which engaged in passenger car manufacturing between 1903 and 1924, more than two-thirds have retired from the field. Less than a dozen have been in the business for the entire period. The average length of life for all 180 companies, has been 8 years.

Questions and Answers

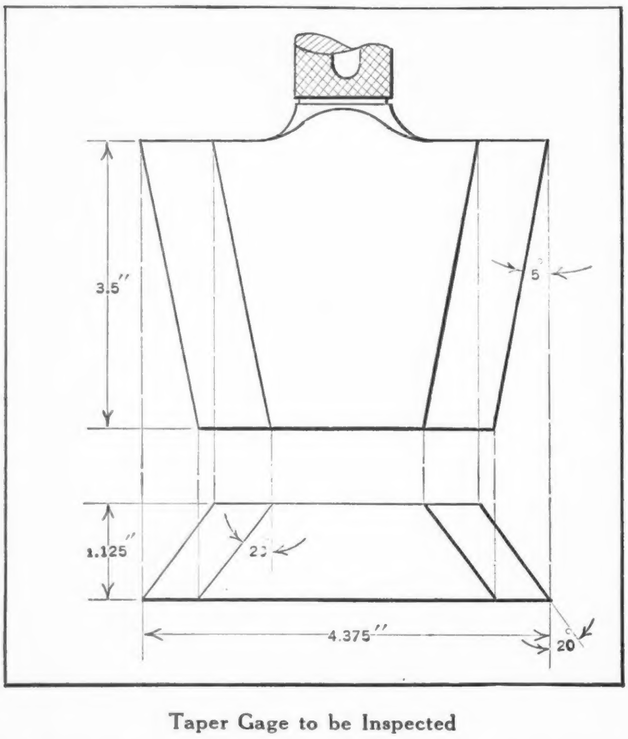
TREATMENT FOR TIN ARTICLES

N. B. I.—I want to find out how a metal product, consisting of several tin parts, may be dipped in hot oil, so that the tin will flow and fill up all cracks and seams. What kind of oil is used, and what temperature must it be heated to? Should the parts be dipped in a cleansing solution prior to the oil dip? How are the parts cleaned after the oil dip?

This question is submitted to MACHINERY'S readers.

MEASURING TAPER GAGE

C. E.—A taper gage with beveled sides, as shown in the accompanying illustration, is required. What is the most practical and convenient method of checking or inspecting the accuracy of this gage?



Taper Gage to be Inspected

A method that can be used in the ordinary toolroom or inspection department, under everyday practical conditions, is required.

This question is submitted to MACHINERY'S readers.

WORKMEN'S COMPENSATION

G. W. L.—Please give examples of the meaning of the term "arising from the course of employment," when applied specifically to workmen's compensation acts.

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

Generally, it must be shown that an injury arose in direct connection with the employment, or the workman is not entitled to compensation under the workmen's compensation acts. Therefore, the outcome of many litigations hinges upon whether or not the injury was received under circumstances that the law defines as "arising from the course of employment."

The higher courts have held that employes are entitled to payment for injuries "arising from the course of employment," under the workmen's compensation laws, in the following instances: Employe accidentally shot while attending to work (109 So. 122); employe shot by hold-up band while attending to work (134 A. 611); employe shot while returning from a journey authorized by his employer (249 Pa. 653); death by contraction of smallpox while in hospital for treatment of bone broken while attending to regular work (210 N.W. 359); injury of truck driver while walking from truck to residence to deliver a package (153 N. E. 624); injury received by workman who left his work to get drink of water; foreman injured while on Sunday trip to obtain workmen (135 A. 129).

The following accidents were held not compensable under the workmen's compensation acts: Employe killed while on way to work (323 Ill. 377); injury received while going home from work (154 N. E. 128); workman injured while making hinges for himself in employer's plant (129 S. E. 667).

The law is well established that where a workman is injured while doing something from which it may be reasonably inferred that he is attending to his regular duties, he is entitled to compensation under the workman's compensation acts (323 Ill. 377).

PROPERTIES OF ALLOYS

L. B.—When metals such as copper, zinc, etc., are melted together to form alloys, is the alloy thus obtained a mechanical mixture or a chemical compound, and do the metals used in the mixture retain the same properties?

A.—When two metals are melted together to form an alloy, the substance formed is, for all practical purposes, a new metal. Its appearance is different from either of the original metals and its properties, in general, are entirely different. Sometimes the alloy is harder than either of the ingredients. As an example may be mentioned brass, which is much harder than either the copper or zinc from which it is made. Most of these mixtures are mechanical in their nature, although they are homogeneous, and some, in fact, form chemical compounds. One of the peculiar properties of alloys, which differentiates them from chemical compounds, is that the percentage of the composition may be changed within certain limits without materially affecting the characteristic properties of the alloy. In the case of a chemical compound, the proportions must always be the same. An alloy of gold and silver will have less electrical conductivity than either of the metals from which it is formed. When a pure metal is cooled to a very low temperature, its electrical conductivity is greatly increased, but the same condition does not obtain in the case of an alloy.

What are "Steel-Rule" Cutting Dies?

By THOMAS P. HOUSLEY

If an experienced toolmaker, without drafting experience, is required to lay out or make a drill jig or milling fixture for which no drawing has been made, he will generally build up the whole thing out of flat stock, nicely screwed together; he naturally starts off along the path most familiar to him. This tendency to work along the path of greatest familiarity, is not confined to the toolmaker alone; the draftsman, tool engineer, and others are similarly inclined. If one is on the lookout, however, it will often be found possible to effect savings by adopting methods used in other lines of work.

A case in point is the use of the "steel-rule cutting dies" used in making novelties. "Cutting rule" is made of tempered tool steel in strips approximately 1/32 inch thick and 0.923 inch (type height) wide, with one edge ground to form a 60-degree cutting edge. This rule is carried as regular stock by printers' supply houses, and is used in printing plants. A die is made by sawing a slot of the required shape in hard wood of suitable thickness, and then bending the steel rule to this shape and driving the rule into the slot, the width of the slot being slightly less than the thickness of the rule, to insure a tight fit. In the novelty industries, these dies are set up for operating either in a printing press with the ink rolls removed or in a commercial cutting and creasing press. In metal-working shops where printing presses are not available, these dies, when suitably mounted can be set up in regular punch presses.

There are many places where these dies can be used in place of the conventional punch press dies, at a considerable saving in cost. Steel rule dies are used for profile cutting of place cards, score cards, window display cards, easels, paper and cork gaskets, and similar products. Dies of this kind have been developed to a high degree in the shops of Peter F. Smith, 516 W. 36th St., New York City. The accompanying illustrations were obtained in this shop.

The form to be cut by the steel-rule die, whether a plain gasket or a fancy form, is carefully drawn on 11/16-inch thick five-ply (laminated) hard wood, and then cut out on a jig saw, as shown in the heading illustration. For starting the saw, holes *A* (see also Fig. 1) are drilled on the outline. The space between the adjacent holes acts as a tie to support the center portion.

Standard cutting steel rule, as mentioned, is cut and bent to suit the outline and driven into the saw cut. A piece of steel rule *H* may be seen in Fig. 1 stuck into a wooden block at an angle to show the cutting edge. In this illustration are also shown a partly assembled die and the bending machine, which is used to bend the rule to the required shape. Jaws to form any required radius or form, some of which are shown beside the bending machine, are quickly interchangeable with the set in the machine.

A piece of steel rule *B* is bent ready to be driven into the section of the slot at *C*. Another piece *D* is ready to be inserted into the section of the slot *E*. The piece *D* is to span the uncut bridge spaced between two holes. Corresponding with the position of the bridge, a section *F* is nicked out of the steel rule. When this piece is driven into place, it will

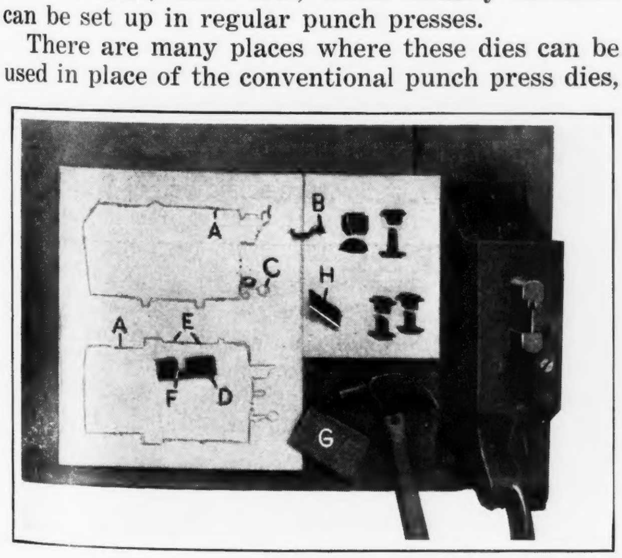


Fig. 1. Die Partly Assembled with Steel Cutting Rule—Bending Machine to Right

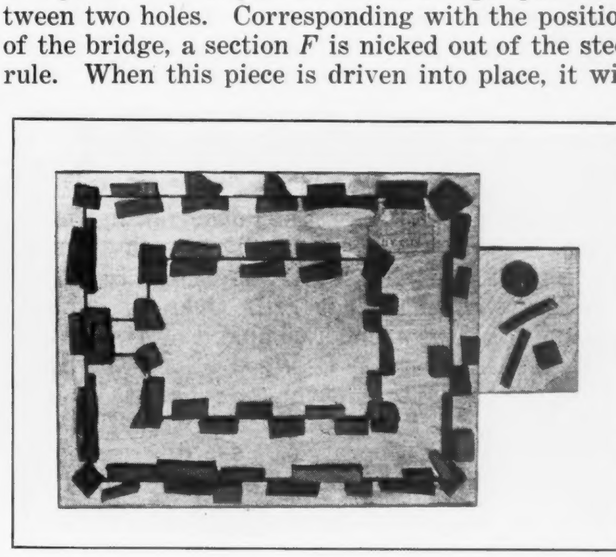


Fig. 2. Die with Pieces of Sponge Rubber Along Cutting Edge for Stripping

cut a path for itself in the bridge to about the depth of the top ply of the wood, which will still leave a substantial bridge but at the same time will form an uninterrupted cutting edge. To safeguard against dulling the cutting edge of the rule when driving it into place, a piece of fiber or wood *G* is placed on top of the cutting edge to take the blow of the hammer. The die rests on flat metal while being assembled to insure that all pieces of the rule are driven to the same depth.

When the die is fully assembled, pieces of sponge rubber suitably placed are glued around the cutting edge and project a distance above it, as shown in Fig. 2. Some extra pieces of the rubber are shown to the right of the die. The function of the rubber is comparable to a stripper on conventional dies.

The die illustrated in Fig. 3 is set up in a standard cutting and creasing press. It is mounted exactly like a printer's type form, and the stock to be cut is located on the press bed and fed in the same manner and at the same speed as in printing. The press is set so that the cutting edge of the steel rule just goes through the stock to be cut, barely touching the steel bed of the press. In the job illustrated four spacers are being cut at a time out of corrugated paper. These spacers are to be used in the bottom of a toy box to prevent the tin toys from being jumbled and nicked. One of the four pieces just cut has the punchings removed and is set up to give a clearer view.

Fig. 3. Steel-rule Cutting Die Mounted in Cutting and Creasing Press

These dies can cut stock as heavy as 0.120 inch. For stock thicker than this, a special hard steel rule is used. A run of 100,000 without resharpening, is usual on 0.040-inch cardboard stock. The construction cost of these dies, as compared with the conventional die, is extremely low.

* * *

POWER TRANSMISSION ASSOCIATION MEETING

A regional meeting of the Power Transmission Association (with headquarters in the Drexel Building, Philadelphia, Pa.) was held March 30 at the Hamilton Club, Chicago, Ill. Over one hundred representatives of member companies were present. W. H. Fisher, of the T. B. Wood's Sons Co., president of the association, outlined its growth and the scope of its activities. G. C. Miller, president of the Dodge Mfg. Corporation and a director of the association, spoke on the subject "The Future of Power Transmission," and a number of members joined in the discussion that followed. The need for a power transmission handbook was emphasized by Robert W. Drake.

AMERICAN FOUNDRYMEN'S CONVENTION

The convention and exhibition of the American Foundrymen's Association to be held in Philadelphia, Pa., May 14 to 18, will be of particular interest from a metallurgical and technical point of view. A large number of papers are to be read at the numerous sessions to be held. Technical sessions are scheduled for Tuesday, Wednesday, and Thursday forenoon and afternoon, and Friday forenoon during the week of the meeting.

Tuesday, May 15, non-ferrous metals, steel founding, cupola developments and foundry costs will be dealt with. Wednesday, May 16, the forenoon meeting will cover steel metallurgy, cast iron founding, and malleable iron, while the afternoon meeting will be devoted to brass founding, foundry management, and foundry coke. Thursday forenoon, May 17, apprentice training and cast-iron metallurgy will be discussed, and in the afternoon the subject of sand control will be dealt with. The Friday session, May 18, will be devoted to materials handling.

Following the practice of recent years, the association will sponsor an apprentice contest in steel molding, gray iron molding, and patternmaking. Local contests have been held in such centers as Chicago, Milwaukee, Schenectady, Philadelphia, and New England. The winning apprentices in these local contests will come to Philadelphia, where the final contests will be held and prizes awarded.

Further details may be obtained from R. E. Kennedy, technical secretary, 909 W. California St., Urbana, Ill.

* * *

AMERICAN WELDING SOCIETY MEETING

The annual meeting of the American Welding Society was held at the Engineering Societies Building, 29 W. 39th St., New York City, April 25 to 27. Five technical sessions were scheduled at which the committees on different technical problems met and papers were read and discussed. Among the papers read were the following: "Welding Corrosion Resisting Steel Alloys," by W. B. Miller, Union Carbide and Carbon Research Laboratories; "Building Up Rail Ends by the Electric Arc Process," by H. E. McKee, Electric Rail Weld Service Corporation; and "Welding the Ford Car," by M. L. Eckman, welding supervisor, Ford Motor Car Co. The committees on pressure vessels, structural steel welding, qualification of welders, and inspection and supervision, held meetings during the convention. The American Bureau of Welding also held its annual meeting on April 27.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, April 16, 1928

SINCE last month no substantial change is noticeable in the state of industry as a whole. The foreign trade returns for February are perhaps not quite so favorable as those for January, imports showing a decrease of £1,540,851, and exports a decrease of £2,506,585. Reports, on the other hand, showed an increase of £1,358,104. The unemployment figures continue to show improvement, the returns reported in March indicating a total of 1,066,100 as compared with 1,136,700 in February, and 1,078,530 in March, 1927.

Conditions in the Machine Tool Industry Improve

With the gradual recovery of industry, conditions in the machine tool field continue to improve, and the volume of orders from the textile, electrical, and railway industries has improved considerably of late. Generally speaking, makers of turret lathes, screw machines, power presses, and drilling, milling, and grinding machines, are well employed, and full night shifts are being run in many instances.

The heavy machine tool field, which by the nature of its products is always the last section to be affected by any trade revival, is showing definite signs of improvement, and makers report a steady expansion of business during the current year.

Overseas Trade in Machine Tools

The figures available for the first two months of the current year give no indication of any large expansion in the export of machine tools. Tonnage is falling and the ton-value is rising. Imports, on the other hand, are rising in tonnage and falling in ton-value. These tendencies are unfavorable, and while too much significance must not be attached to the returns of two months, they should not, on the other hand, be disregarded.

During February, 1023 tons of machine tools were exported, as compared with 1159 tons in January and 969 tons in December, 1927. The values of exports for the three months in the order given were £130,982, £148,239 and £113,318. The ton-value for February was the same as that in January, namely, £128, as compared with £117 in December.

Imports in February amounted to 716 tons, as compared with 921 tons in January and 595 tons in December, the corresponding values being £85,-715, £133,822, and £89,894. A sharp fall in ton-values occurred over this period, the figure for February being £120, as compared with £145 in January and £151 in December.

The Automobile Industry Shows Activity

Since the beginning of the year conditions in the automobile industry have been somewhat depressed, but it is an encouraging sign that several of the largest manufacturers are now hiring men in considerable numbers. The heavy taxation of road motor vehicles in this country constitutes a severe handicap to the industry.

A remarkable feature of the British automobile industry has been the consistent lowering of prices and simultaneous improvement in design, performance, and equipment, and whereas during 1927 the index of cost of living stood at 167, as compared with 100 in 1914, the prices of private cars and commercial vehicles ascertained by averaging over a number of models stood at 88.4 and 104.2, respectively, by comparison with 100 in 1914.

In 1926 the British automobile export trade formed 6.5 per cent of the world's total exports of automobiles, as compared with 11.8 per cent from France, 6.7 per cent from Italy, 14.6 per cent from Canada, and 60.3 per cent from the United States. During the first half of 1927, the percentages exported by the countries named, in the order given, were 6.7, 8.1, 5.8, 11.4, and 68.

The total number of cars produced in Great Britain during 1926 was 180,000, of which 18.3 per cent were exported, while during the same year France produced 210,000 cars of which 28.4 per cent were exported, and Italy 55,000, of which 62.1 per cent were exported.

Iron and Steel Production

Figures issued by the National Federation of Iron and Steel Manufacturers indicate that the production of pig iron in February was 550,800, as compared with 560,500 tons in January and 571,100 tons in February, 1927. The production of steel ingots and castings in February amounted to 764,400 tons, compared with 626,200 tons in January, and 826,800 in February, 1927.

In sections of the metal-working industries other than those mentioned, there is little change to be recorded. From the number of important contracts recently booked it is evident that electrical engineering continues to be one of the best employed sections. While conditions are somewhat spotty in the railway engineering shops, some substantial orders on both home and overseas account have lately come to British firms, and the degree of employment, although remaining substantially stable, is, if anything, on the up grade.

* * *

A new technical society, a name for which has not yet been adopted, has been formed in New York City under the leadership of Dr. Robert Grimshaw, 65 Jesup Place, New York City. The objects of the new society are somewhat similar to those of the Franklin Institute of Philadelphia. There are fifty charter members, among whom are seventeen members of the faculties of Columbia University, New York and Fordham Universities, and New York City College. The object of the society is to cooperate with the existing engineering, electrical, and other societies.

Time Studies in a Plant Manufacturing a Variety of Machines

By HERBERT K. KEEVER, Mechanical Engineer in Charge of Production, McDonald Machine Co., Chicago, Ill.

IT is generally understood that the real purpose of time studies is to reduce manufacturing costs by selecting the most efficient and economical method of performing a definite task. In a plant manufacturing a great number of different parts in small quantities, it is sometimes difficult to determine just where to begin time-study analyses. Some engineers advise starting with the assembly departments and analyzing the machine as a unit, with a view to obtaining data as to necessary allowances and tolerances on parts. This is necessary in a great number of cases, but it has been the writer's experience that greater savings in cost are possible by studying individual machine parts, using the assembly as a guide when questions of tolerance and finish are brought up.

Herbert K. Keever

Grouping Parts for Time Study

When a great variety of machine parts are manufactured, as in plants building special machinery, an analysis of the parts can usually be made according to general similarity. As an example, all drawings of gear brackets were grouped and classified according to three distinct styles of parts. One group contained all gear brackets of a box type of construction, the second group all brackets consisting of a flat baseplate, and the third group a miscellaneous assortment which could not be classified under the other two groups. A further analysis was made of these brackets, and it was found that by adding several bosses and pads to one part, it could be used for three additional parts.

All cams, pins, studs, gears, collars, washers, feed-fingers, adjusting screws, and similar parts were grouped in a manner similar to the gear-boxes. A surprising number of similar parts were discovered. In the case of coil springs, about half of the existing number of parts were eliminated. This grouping of parts, to the uninitiated, had absolutely nothing to do with time studies, and yet it formed a nucleus about which the complete time study and wage incentive system was constructed.

HERBERT K. KEEVER graduated from the mechanical engineering department of the University of Cincinnati, in 1922. During the following year he was employed by the Cincinnati Milling Machine Co., in the sales estimating department, and later was in charge of the time study and routing department of the Acme Machine Tool Co., Cincinnati, Ohio. In 1924, he became associated with the McDonald Machine Co., Chicago, Ill., as mechanical engineer in charge of production. In this position he has organized the time study, planning, and production system now in operation at this plant, where automatic metal-working and stamping machinery is manufactured. His present duties include supervision and further development of the production system.

If the various parts had not been classified, time study and analysis work would have been done on a great many duplicate or unnecessary parts. A further advantage of this grouping was that it enabled a uniform system of wage rates to be established. By going through each group systematically, it was possible to have all rates on a similar class of parts in proportion, and no great variation occurred. In some plants with which the writer is familiar, considerable trouble has been caused by a discrepancy in rates on similar parts. Had these parts been grouped and all rates set at one time, this would not have occurred.

Charts Listing Grouped Parts

A "machine group part" chart may have, for instance, a list of the various cams used upon the different models of the machines built. The name and symbol number should be listed in a column at the left-hand side of the chart, while columns under different numbers at the right show which machining departments the part passes through. Under each department heading, there are spaces for listing the standard rates as they are set. This type of chart enables one to see at a glance what has been accomplished in studying the operations of a given class of parts.

Preparation for Time Setting

Before any great amount of accurate time estimating on the various groups of standard parts was accomplished, it was necessary to obtain existing shop standards and data. Handling times were carefully observed, with an idea of installing labor-saving equipment wherever needed. Special air hoists were rigged above some of the machine tools and the standard lifting time observed. The maximum cutting capacity and speed of various tools were determined and charted. A speed and feed chart was made for each, arranged in convenient form for ready reference. Range charts of the various machine tools were made, listing the amount of travel, swing, clearances, and other potential information.

Classification of Machines and Work

A theoretical machine grouping was developed, dividing all equipment into four general classes, according to the skill required to operate the machine. This classification also included a careful analysis of the work done on the machine. A crankshaft lathe used for finish-turning crankshafts was put in the first class, because a high degree of skill

is necessary to machine a crankshaft correctly. The grouping also permitted a uniform standard of hourly wages to be established, new men being put in the fourth group and gradually advanced to the first group as their skill increased and vacancies occurred.

The machine group classification plan served as an advantage when the actual time-study work began. The time-study engineer had a definite idea as to the class of skill available in each group. The class of labor required to perform a given operation on a part could be approximately determined from a study of the blueprint of the part. When making a time study, definite constants of motion time were known for each class of operator. The time-study engineer had definite assurance that the operator of the machine would have a fair chance to maintain the standard time allowance.

Rules for Setting Rates

A few simple rules were also formulated for the guidance of the time-study men. Briefly stated, they are as follows:

1. Speeds and feeds are to be set according to the practice considered best by the time-study department, in conformance with the standards that have been charted for the various classes of material worked upon.
2. All tools required for such feeds and speeds must be on hand in the plant or tool-crib.
3. If such tools are not on hand, they should be made, provided a year's increase in output will pay the additional expense.

Gains made by using new tools during the year should not only include time savings, but all the beneficial results obtained by the substitution of a higher grade tool. These results are shown in increased output, less delay, quicker deliveries, possibility of making a single machine do, where with slower feeds and speeds two might be required, one of which might have to be purchased.

4. If no available machine has the required power or speed range, time should be set for the machine that comes nearest to meeting the requirements.
5. A record should be kept, for reference, of a machine that has proved ideal for any given job. This record should contain the number and name of the piece, depth of cut, and the feed and speed required.

Improvements Suggested by Foremen

As most of the time studies were made from standard data, it was necessary to devise some plan to accommodate the suggestions for the improvement of methods made by the shop foremen. A general order was issued to the foremen to the following effect: "Foremen are asked to consult with the time-study department on suggested changes in operation, feeds, speeds, or tools which in their opinion seem desirable." It was also suggested that to enable the time-study department to consider the suggestions for improvements made by the foremen, the suggestions be made while the job was in process in the factory.

All the work of grouping the parts and the machine tool equipment was carried on simultaneously by time-study engineers. After the necessary data had been obtained and charted, the setting of premium standards began.

Working Instructions for the Shop

Instruction cards were made which clearly explained the method of performing the work in order to earn a wage premium. These cards, in blueprinted form, were mounted on lightweight sheet iron, and could be obtained by the men on the presentation of a check at the tool-crib. Instruction cards showed in detail a sketch of the set-up, feeds, speeds, tools required, and both the standard and premium time allowances. The instruction card also stated that a time standard, once established, would not be changed unless there was a change in tools, specifications, equipment, etc.

From the charts of the machines and a knowledge of shop work in general, time-study estimates were made and rates set. These standards have been in use for several years, and have proved a vital factor in maintaining a low and consistent manufacturing cost.

* * *

What Is Patentable?

Few engineers and designers have a clear understanding of what is actually patentable and to what extent a patent really protects the inventor. June MACHINERY presents the first of a series of articles on patents by H. L. Kauffman, whose experience and training have given him an unusual opportunity to learn specific facts relating to patents and patentable inventions and to place them before the readers of MACHINERY in simple, clear-cut language. Many inventors have failed to derive any material benefit from their inventions because they have not been sufficiently informed on certain phases of patent practice. The claims made for their inventions may not have been broad enough, or they may have claimed only one application when the patent had a much greater field. Mr. Kauffman's articles will give men engaged in the mechanical industries a better conception of what is patentable and the safeguards required to adequately protect inventions.

CONTEST FOR DRAFTING APPRENTICES

The Milwaukee Branch of the National Metal Trades Association held a contest on March 19 in which draftsmen apprentices in Milwaukee shops were entitled to compete. Sixteen apprentices took part in the contest. Each emloyer was permitted to enter one contestant for each five drafting apprentices on the payroll. The contest consisted of making a bearing design and solving six practical problems in mathematics.

The contest was held in the drafting-room of the Milwaukee Vocational School. The solutions submitted were marked by numbers and were not identified by names. The first prize was won by Ray Pickel, a drafting apprentice of the Falk Corporation; the second prize by Eugene Semrod of the Filer & Stowell Co.; and the third prize by Carl Meyer of the Allis-Chalmers Mfg. Co. In addition, honorable mention was given to Orval Sellmer of the Allis-Chalmers Mfg. Co. Similar contests are also conducted annually by the Metal Trades Association in Milwaukee in machine work, iron and steel molding, and patternmaking.

Replacing Castings with Welded Steel

By R. A. GAST, Production Manager, The Lincoln Electric Co., Cleveland, Ohio

R. A. GAST, after having completed a high-school education and two years of college, obtained practically all of his training and experience with the New York Central Railroad and the Lincoln Electric Co., at which latter plant he is now production manager. During the last ten years he has visited a great many plants to observe the best manufacturing methods with the view of developing the best possible means for obtaining production in the arc welding field. His attention has been given especially to the application of methods that lower production costs, reduce inventory, and make possible quicker deliveries.

To many, the use of welded steel in place of castings seems difficult in the case of the more complicated castings, but in reality it is not so difficult as it would appear. It is possible that there are metal shapes and structures whose fabrication is beyond the realm of the electric arc welder. To fall within that class, however, an article would have to be of much more elaborate and involved design than the average commercial machine part.

A Welded Construction Supersedes an End Bracket Casting

In the early years of welding, it would hardly have seemed possible that such a complicated piece as a motor sleeve-bearing end bracket, with its curves and fillets, would some day be produced by welding, not only more easily, but also more cheaply than by the conventional foundry methods. Today, the Lincoln Electric Co. produces large motor end brackets from common commercial steel shapes by this method at a saving of over 42 per cent.

In addition, a considerable gain in strength and rigidity and a reduction of 50 pounds in weight have been effected. The cast motor end bracket shown in Fig. 1 weighed 215 pounds and cost $12.16. It has been superseded by the welded steel end bracket shown in Fig. 2, which weighs only 165 pounds. The production cost, for labor and material, is $7.03. (These figures do not include overhead, bearing, or oil-ring costs in either case).

In changing the method of producing a part from casting to welding, it is absolutely essential to forget foundry procedure. The rounding curves and fillets that designers have always liked to introduce should be forgotten, and the structure thought of in terms of pure strength and utility. Whether, when one does that, the resultant article is more or less good looking is a matter of opinion, and opinions in this respect are largely a matter of habit. To some, accustomed to the appearance of castings, welded parts may not appear graceful; to others, a machine seems to gain rather than lose in appearance, when the simple and strictly severe steel shapes are used in its construction.

Fig. 1. Cast-iron Motor End Bracket Replaced by the Welded-steel Bracket Shown in Fig. 2

Parts Employed in Constructing the Welded End Bracket

The replaced casting shown in Fig. 1 was rather complicated, as it contained not only an oil reservoir, but also a bearing support. To secure the necessary results with a welded construction, considerable thought was required, but this effort was well repaid, as is seen from the cost figures.

The parts from which the end bracket is made are shown grouped in Fig. 3. Ring *A* is cut from a piece of straight angle-iron, chamfered on the ends for welding, and rolled into shape. The adjoining ends are then welded and the weld ground, after which the part is drilled as shown. Arms or spokes *B* are made of channel iron from stock. They are cut to length, chamfered, bent to a slight radius, washed, and burred. Sides *C* of the bearing shell are also pieces of channel iron. The necessary operations in forming them are cutting, burring, and punching.

Cap *D*, which covers the outside shaft opening in the bearing box, is formed from a sheet-steel blank in a drawing die. The shaft hole is then punched. Rings *E*, which are welded to the bearing housing to form the suspension, are made of square stock, sawed to the desired length and formed in a punch press. Tube *F*, which may be seen in Fig. 2 extending from the rear of the bearing housing, is a piece of flat sheet in its original form. It is shaped in a horning press. Bottom *G* of the bearing housing and oil reservoir is merely a piece of steel plate blanked to the proper size. Lug or key *H*, which is used to hold the bearing stationary, is cut from a piece of key steel.

Operations Involved in Making the Welded Part

The assembly of these parts is divided into nine operations, as follows:

Operation 1—Two rings *E* are welded to the back channel iron *C* about the shaft hole, and lug *H* is welded on.

Operation 2—Cap D is welded to the front channel iron C.

Operation 3—Two rings E are tack-welded to the other side of the same channel iron.

Operation 4—The last two rings E are welded to tube F and the tube, in turn, is welded to the rear channel iron C.

Operation 5—The front and rear channel irons of the housing are assembled in a jig and welded together, and then bottom plate G is welded on.

Operation 6—The bearing housing assembly, now being complete, is ground to remove any rough edges and to prepare it for the oil-box cover.

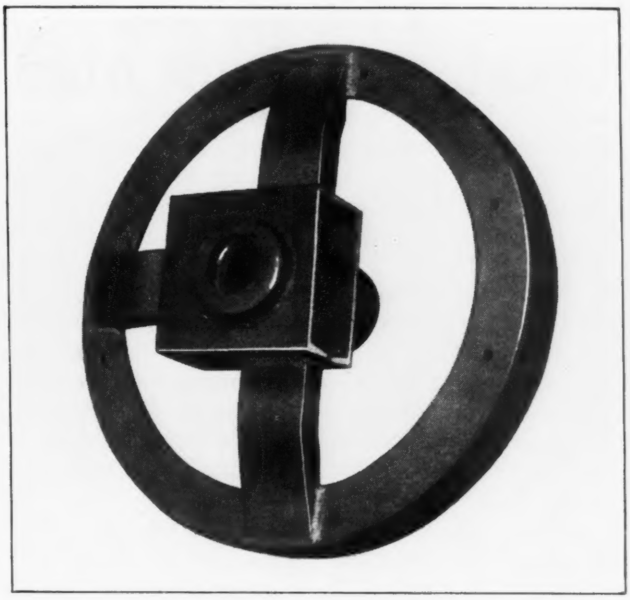


Fig. 2. All-steel End Bracket Constructed by Arc Welding

Operation 7—The screw-holes are drilled and tapped for the cover.

Operation 8—As the bearing housing is now in the finished state, arms B are welded to it and to ring A. This is done in a jig.

Operation 9—The oil connections are tapped in, and the end bracket is completed.

This procedure may seem elaborate, but, as a matter of fact, the total labor time consumed in all of the operations is only 4 1/2 hours, and the total labor cost is but \$3.15. The average fillet weld is 3/8 inch, there being a total length of 12 linear feet. As the total actual welding time is 42.5 minutes, it will be seen that it is done at the rate of 17 feet per hour.

The question as to what size of electrode to use for this kind of work is usually asked. At the plant of the Lincoln Electric Co., the largest practical size is used, and in this case, most of the work is done with a 3/16-inch electrode. The rate or speed of welding is dependent upon the rate at which metal can be melted and handled; consequently the larger the electrode that can be used with the proper current, the faster the speed of welding.

A Comparison of Costs

Fig. 4 shows a motor fitted with the welded end bracket. In the writer's mind, the appearance is improved by the substitution of an arc-welded end bracket for the cast-iron one. The comparative costs are as follows:

Cast-iron Bracket

Material	\$11.47
Labor	0.69
Total	\$12.16

Welded Steel Bracket

Material	\$3.88
Labor	3.15
Total	\$7.03

Overhead costs are not included, since they vary widely in different plants. The actual saving in labor and material with the welded bracket is \$5.13, or over 42 per cent.

Such savings are possible because of the fact that steel is five times as strong as cast iron and two and one-half times as stiff, and yet costs only one-third as much per pound. Thus the weight of parts can be materially reduced by using a welded part, and with the lower cost per pound, the material cost is also reduced.

* * *

In a letter to the *Journal of the Society of Automotive Engineers*, John Nolan of Boston, Mass., states that already there are more than 4000 airports and landing fields of some sort in the United States. The records show that the cost of airports varies from about \$10,000 up to \$1,000,000.

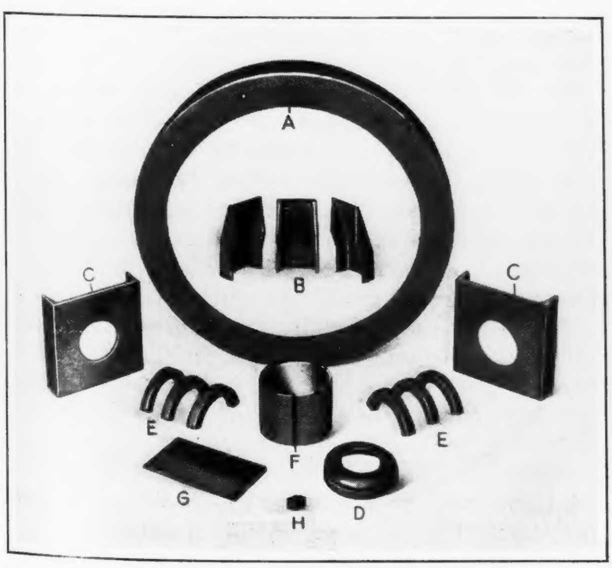


Fig. 3. Detail Parts of the Welded End Bracket

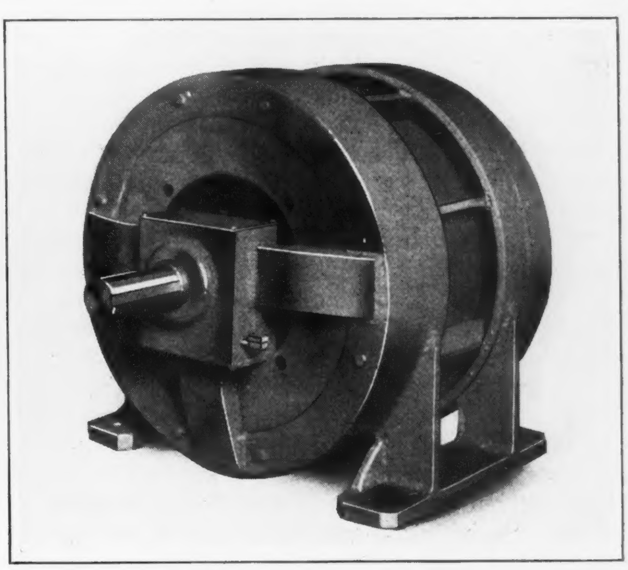
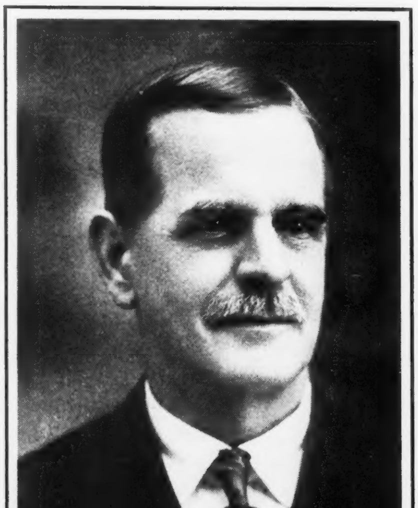


Fig. 4. Welded Bracket on an All-welded Motor

Annual Meeting of Gear Manufacturers

THE twelfth annual meeting of the American Gear Manufacturers' Association was held at the Hotel Seneca, Rochester, N. Y., April 19, 20, and 21. The meeting was unusually well attended, and was conducted along lines similar to those followed in previous meetings of the association. A great deal of attention was given to standardization work, an activity that has been foremost on the association's program ever since its formation. The first session was called to order by the association's president, E. J. Frost, president of the Frost Gear & Forge Co., Jackson, Mich., after which an address of welcome to Rochester was made by A. C. Gleason of the Gleason Works of that city. This was followed by the usual presidential address, during the course of which Mr. Frost quoted the following statement from a house organ in the industrial field:

"When a business firm attempts to mold its whole policy so as to meet the prices of its competitor that business is entering a labyrinth, the center of which is the chamber of despair. Highest quality never can be given, nor obtained, at the lowest prices. If a price is to be sacrificed, quality must be sacrificed. If quality is sacrificed, society is not truly served."



A. F. Cooke, Newly Elected President of the American Gear Manufacturers' Association

"While this is true," said Mr. Frost, "it is equally true that progress is going on all about us. We must not try to get along with more or less antiquated equipment and growl at the fellow who provides himself with up-to-date machinery and tools, and who is as a logical consequence, able to make more attractive prices and still make a satisfactory profit—perhaps even a greater profit than the man with higher prices and less adequate facilities. It is not safe for us to forget for one moment that general development leads to the constant cheapening of all commodities, and has a tendency to broaden sales and make for quantity production.

"It is well for us to bear in mind, as an industry organization, and as individual members of this association, the responsibility that must be ours in this, the most wonderful age of progress and material achievement the world has ever seen. We must bear our share in the general program of reduction of costs to the consumer, so long as such reductions can be made through increased efficiency of men, methods, and machines.

"Quality must not be sacrificed for quantity, but increased production must be obtained through better education of our producers, through elimination of wastes that are common in nearly all shops, through creating an active interest on the part of the workmen that will make each man feel that he is not a mere routine worker, but that he is a definite unit in a coordinated whole. The office, too, should bear its share of the program by buying satisfactory materials at right prices, by seeing that materials are in the shop on time, that jobs are started in their proper sequence, and that great care is given to the selection of the most efficient machine tools and small tools, furnaces and other equipment.

"While we are speaking of efficiency, let me say that I believe sincerely in the wisdom of the adoption of some plan to minimize industrial accidents, to prevent sickness, and to provide proper first-aid and nursing service. Many costly mistakes are made because workmen should be wearing glasses, and it often happens that the man knows nothing of his need until his eyes are examined.

"Good-will and peace of mind among workmen are wonderful assets in any manufacturing plant, and these things have to be cultivated, if not actually earned, by the management through relationships that are founded on mutual understanding and a working adaptation of the Golden Rule. To quote Charles Schwab: 'Today, co-operative action is essential as a means of advancing the interests of any industry. The day of the individualist, when personal interest overshadowed all other motives, has passed. It has been forcibly demonstrated that individual prosperity depends absolutely upon the success of the industry; that no individual can permanently prosper at the industry's expense.'"

Mr. Frost further emphasized the need of research and testing laboratories, and said that it behooves industry not only to employ the well trained men of our universities, but also to see to it that young men of unusual ability are educated for our future needs.

"Instead of eternally talking about prices," said Mr. Frost, "let us see if preventing or at least salvaging some of the enormous waste in industry will not only change loss into profit, but add unexpected zest to our jobs, if for no other reason than because of the novelty of the undertaking."

Papers Read Before the Meeting

A number of papers were read before the meeting. G. A. Round, assistant chief engineer of the Vacuum Oil Co., spoke on "Gear Lubrication." T. C. Roantree of the Westinghouse Electric & Mfg.

Co., read a paper entitled "Non-metallic Materials —What Part Will They Play in the Future of the Gear Industry?" C. E. Skinner, assistant director of engineering, Westinghouse Electric & Mfg. Co., spoke on "The Value of Research to the Present-day Manufacturer." W. H. Phillips, of the Molybdenum Corporation of America, addressed the meeting on "The Nitration of Steel." J. C. O'Brien of the Pittsburgh Gear & Machine Co., read a paper on "Contact of Standard Worm-gears." An address outlining how advertising can be planned and directed on a nation-wide plan without involving the uncertain factors frequently accompanying so-called "national advertising," was made by J. C. McQuiston, of the Westinghouse Electric & Mfg. Co. At the annual dinner, Dexter S. Kimball, dean of the College of Engineering, Cornell University, made the principal address.

The Growing Importance of Research

In his paper on "The Value of Research," Mr. Skinner mentioned that the latest available information shows that we now have in the United States upward of 1000 industrial research laboratories with well over 10,000 trained research workers aided by a small army of assistants, mechanicians, glass-blowers, helpers, etc. No accurate statistics are available giving us the annual expenditure in this country for industrial research, but this runs into many millions of dollars, and a number of individual laboratories have budgets of a million or more dollars a year. These are very impressive figures, and themselves definitely answer the question as to whether research is of value to present-day manufacturers.

As a rule, the principal function of the industrial research laboratory is to develop new and useful products and processes for the industry it serves. In some cases, its main function may be, in co-operation with customers, to develop new uses for products already developed. It may be established for the main purpose of improving manufacturing processes or aiding the development of new devices and applications based on some outstanding invention which provides the main product of the manufacturers served. Most industrial research laboratories find that an inevitable part of their work consists in curing and anticipating troubles either with the product, the processes involved, or the application of the product.

Some years ago, a committee of the American Society for Testing Materials was organized for the purpose of evolving a specification for automatic screw stock steel. It was found necessary to undertake a research to determine the characteristics of steel made by both the open-hearth and Bessemer processes, as there was not sufficient knowledge at the time on which to base a specification satisfactory to all concerned. This research led to the establishment of these two grades of steel, which have become the standard for this general class of work. During the series of tests made on different experimental lots of steel, it was discovered that cutting speeds could be greatly increased, so that not only was a satisfactory grade of steel produced, but the output of screw machines was more than doubled in many instances. This is but one evidence of the great value of research.

No manufacturer can expect to keep abreast of the present-day progress of industry, except by the utilization of the results of research either carried on by himself or by others. In fact, successful results obtained in industrial research, while of primary value to the group controlling it, are of ultimate value to all industry.

Progress of Standardization Work

A considerable number of reports relating to standardization were presented. A comprehensive nomenclature for bevel gears was submitted by the nomenclature committee. This report is a distinct contribution to the literature on bevel gearing, and great credit is due the committee, of which Douglas T. Hamilton, of the Fellows Gear Shaper Co., Springfield, Vt., is chairman.

A proposed revision, involving much painstaking work, of the association's practice for forged and rolled alloy steel for gears was submitted by the metallurgical committee, of which C. B. Hamilton, Jr., of the Hamilton Gear & Machine Co., Toronto, Ont., is chairman. The other committees on standardization presented progress reports.

During the meeting, the association was entertained at luncheon at the Gleason Works on Friday, April 20, following which the members visited the plant of the Gleason Works and were shown many of the new developments of the company.

Officers for the Coming Year

The following directors were elected: E. W. Miller, Fellows Gear Shaper Co., Springfield, Vt.; E. J. Frost, Frost Gear & Forge Co., Jackson, Mich.; F. B. Drake, Johnson Gear Co., Berkeley, Cal.; P. L. Tenney, Muncie Products Division, General Motors Corporation, Muncie, Ind.

Warren G. Jones, W. A. Jones Foundry & Machine Co., Chicago, Ill., was elected to fill a vacancy created by the resignation from the board of directors of F. W. Sinram, Gears and Forgings, Inc. Mr. Sinram was elected an ex officio member of the board.

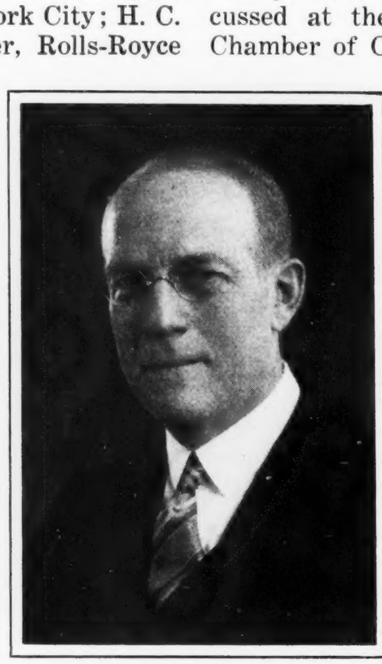
The officers elected are: A. F. Cooke, Gears and Forgings, Inc., president; B. F. Waterman, Brown & Sharpe Mfg. Co., first vice-president; E. W. Miller, Fellows Gear Shaper Co., second vice-president; and Warren G. Jones, W. A. Jones Foundry & Machine Co., treasurer. T. W. Owen, 3608 Euclid Ave., Cleveland, remains secretary.

* * *

The methods of gas and electric welding are so comparatively new that while a great many tests have been made to show the strength of joints so made, there have been few performance records where the welds have been subjected to the test of time. In view of this, it is interesting to note, in *Oxy-Acetylene Tips*, that a gas main laid by a public utility company in Pennsylvania in 1917 has never given any trouble in the ten years during which it has been in use. Recently, in making some changes, a section of this line containing two welds was cut out. The welds were examined and found to be in perfect condition. This is of particular interest in view of the fact that the line has been subjected to stray electric currents for some time, and electrolytic action might have been expected.

NATIONAL METAL TRADES' CONVENTION

The thirtieth convention of the National Metal Trades Association was held at the Hotel Astor, New York City, April 25 and 26. The program dealt with many of the important problems confronting the metal trades industry today, especially in the fields of production and labor. At the meeting the following officers were elected for the coming year: President, Harold C. Smith, president, Illinois Tool Works, Chicago, Ill.; first vice-president, J. G. Benedict, general manager, Landis Machine Co., Waynesboro, Pa.; second vice-president, Jacob D. Cox, Jr., president, Cleveland Twist Drill Co., Cleveland, Ohio; treasurer, J. W. O'Leary, president, Arthur J. O'Leary & Son Co., Chicago, Ill. In addition, the following men were elected councilors to serve for two years: J. H. Van Alstyne, president, Otis Elevator Co., New York City; H. C. Beaver, vice-president and treasurer, Rolls-Royce of America, Inc., Springfield, Mass.; J. C. Spence, superintendent the Norton Co., Worcester, Mass.; R. J. Russell, vice-president and secretary, Century Electric Co., St. Louis, Mo.; Theodore Trecker, Kearney & Trecker Corporation, Milwaukee, Wis.; and Paul T. Norton, president, Case Crane & Kilbourne Jacobs Co., Columbus, Ohio.



Harold C. Smith, New President of the National Metal Trades Association

The retiring president, Paul T. Norton, presented a comprehensive report outlining the activities of the association during the year and covering such important subjects as labor conditions, membership, finances, prevention of industrial accidents, industrial education, industrial relations, publications, business conditions, legislation, and the open shop.

Howard Coonley, president of the Walworth Co., spoke on the subject of "Industrial Budgeting," a method that has become an important factor in modern business administration. Magnus W. Alexander, president of the National Industrial Conference Board, brought before the convention an extended study in the mechanization of the industries and unemployment. The Industrial Conference Board is the leading and most authentic source of industrial statistics in this country.

Public utilities have been the center of interest for several years. Bernard J. Mullaney, vice-president of the Peoples Gas, Light & Coke Co. of Chicago, spoke on "The Government in Business," referring to proposals for investigation of public utilities companies. Dr. Charles J. Bullock, director of the Harvard Economic Survey, Cambridge, Mass., discussed "Business Profits" in a paper which presented a thorough investigation of the subject and introduced what might be called the distant, rather than the immediate, view of the matter.

Walter Gordon Merritt, counsel for the League of Industrial Rights, spoke on "The Significance of the Present Situation to Change the Laws in Respect to Labor Combinations." At the annual banquet held in connection with the convention, Hon. Charles Nagel, former Secretary of Labor, chose the subject "The Majesty of Law."

Other discussions of the problems of industry included one on foreman training, led by George W. Seyler of the Lunkenheimer Co. of Cincinnati. Wage incentives for workmen and supervisors were also discussed.

The association has grown continuously for thirty years, and now has approximately 1100 firms in its membership, employing in the neighborhood of 1,000,000 men.

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MEETING OF THE CHAMBER OF COMMERCE

Manufacturing problems, excessive competition, over-production, and shrinking profits will be discussed at the sixteenth annual meeting of the Chamber of Commerce of the United States to be held in Washington, D. C., May 7 to 11. "Teamwork for Profits in a Consumers' Market" is the subject of an address to be made by E. J. Mehren, vice-president of the McGraw-Hill Publishing Co. "Forecasting and Planning is Vital to Industrial Prosperity" is the title of a paper to be presented by Donaldson Brown, vice-president of the General Motors Corporation. Mr. Brown will emphasize the need for dependable statistical information of what is going on in industry to prevent over-production and unintelligent competition.

Human relations in industry, including such questions as unemployment, the elimination of workers by labor-saving machinery, and the need for better trained workers and supervisors, will be dealt with in a paper by C. S. Ching, manager of the employment division of the United States Rubber Co. and president of the American Management Association, who will speak on "Labor Conservation—Teamwork for Lower Costs of Production."

* * *

AUTOMOTIVE PRODUCTION COMMITTEE

To assist in developing the activities of automotive production engineers, a production advisory board consisting of chief executives in the automotive industry has been formed by the Society of Automotive Engineers, and a production committee appointed to carry on the work actively. This committee is divided into seven groups, each of which is to handle a definite class of subjects. One group will promote activities of the regional sections of the society in the matter of meetings for the discussion of production problems. Another is to devote its attention to the development and use of standards in production engineering. Other groups will deal with manufacturing processes and equipment, material handling, time study and personnel relations, production expenses, and inspection methods.

PUNCH PRESS GUARD WHICH PERMITS CLEAR VIEW OF WORK

Visibility of the work is one of the main features of a guard which is being provided on punch presses in the shop of James A. Matthews & Co., Pittsburgh, Pa. As shown in Fig. 1, this guard insures complete protection to the operator. It need not be removed to permit the substitution of dies, as will be apparent from Fig. 2. Still another feature is its adjustability to suit dies of various dimensions. The guard is of light-weight construction and is easily applied to a machine.

Guards of this design are suitable for punch-press operations in which strip metal is fed from right to left or vice versa and in which the scrap passes out of the die on the opposite side. The right and left wings of such a guard are made up of expanded metal. These wings are hinged and can be clamped in various positions to suit different widths of dies. The door at the front of the guard is made of plate glass, 3/8 inch thick, which permits the operator to observe the die and work clearly. This door swings in a vertical plane and may be opened quickly.

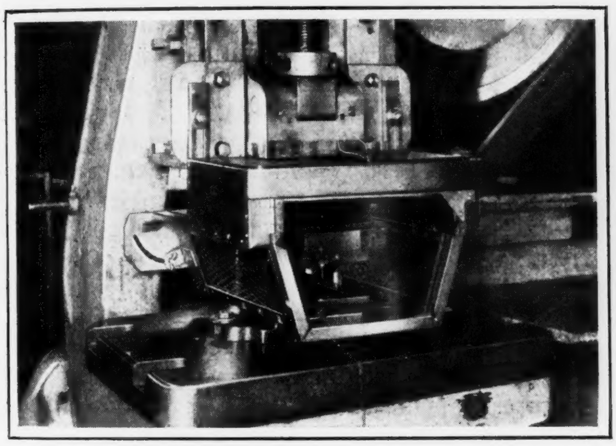


Fig. 1. Punch Press Guard with Glass Front Door

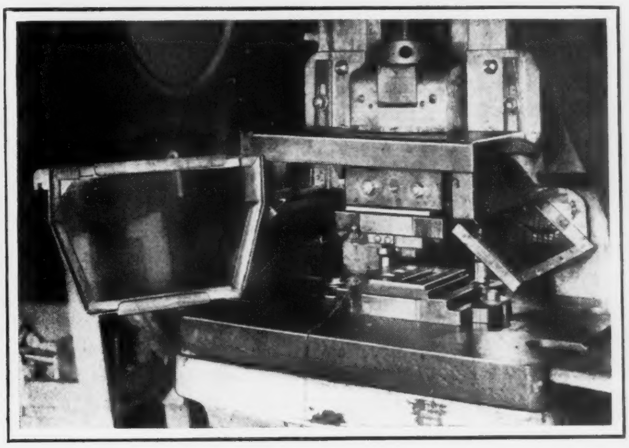


Fig. 2. Guard Opened to Permit Changing of Dies

Raising or lowering of the entire guard on the frame of the machine may be accomplished by loosening two nuts. The die shown in the illustrations is of a progressive or two-step design.

* * *

INDUSTRIAL MACHINERY EXPORTS GROW

The United States' exports of industrial machinery during February, the last month for which complete statistics are available, amounted to over $15,000,000, according to a statement by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce. Compared with the trade of the corresponding month of 1927, there was a gain of $2,400,000.

Metal-working machinery showed a decided advance. The exports in February, 1928, were valued at $2,373,000, as compared with $1,406,000 for the corresponding month a year ago. Shipments of this class of machinery for the first two months of 1928 were 50 per cent ahead of the corresponding period of 1927. The largest gains in this group have been made in the exports of engine lathes, thread-cutting and automatic screw machines, gear-cutting machines, and cylindrical grinding machines.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers will hold its national spring meeting at Pittsburgh, Pa., May 14 to 17, with headquarters at the William Penn Hotel. A great number of papers will be read, and technical sessions will be held on the subjects of machine shop practice, applied mechanics, engineering education, management, heat and fuels, locomotives, power brakes in train operation, seamless tubing, hydraulics, glass manufacturing, materials handling, central power stations, and alloys. The papers in the Machine Shop Practice Division session will be "Some Common Delusions Concerning Depreciation," by Ernest F. DuBrul, and "Ball-bearing Machine Tool Spindles," by Thomas Barish.

The Engineers Society of Western Pennsylvania and the Pittsburgh Section of the American Ceramic Society are cooperating with the American Society of Mechanical Engineers in holding the meeting. One of the features of the meeting will be a tour by special train to the principal plants of the United States Steel Corporation in the Pittsburgh district, where the latest developments in the making of steel will be inspected. One afternoon the plant of the Westinghouse Electric & Mfg. Co. at East Pittsburgh will be visited. The principal social event of the meeting will be the society's dinner on Wednesday evening, May 16, when the Holley Medal of the society will be presented to Elmer A. Sperry for his achievements in the invention of the gyroscope.

* * *

INCREASING THE DIAMETER OF A PULLEY

By CHARLES KUGLER

The method of increasing the diameter of a pulley described in January MACHINERY, page 381, reminded the writer of a method he has used for many years. It consists of wrapping a piece of belting around the pulley and making it fast with copper rivets. Holes for the rivets can be drilled in the rim of the pulley with a breast drill or an electric drill when the work cannot be brought to a drill press. The writer believes that the leather belting is more durable than the adhesive tape, but it cannot, of course, be applied as quickly or conveniently.

Are Machine Tool Prices Really High?

By A Machine Tool Sales Manager

PREVIOUS to the war, machine tools were purchased very much as we buy razor blades today. The price asked was paid, the machine installed, and its operation was a matter strictly between the buyer and the machine. No one else was concerned. The buyer did not insist on knowing just what production could be expected, or how many months the machine would take to pay for itself. The manufacturer heard nothing more from him until a repair part or another machine was wanted.

Then the buyer's attitude changed completely. Blame it on the war if you will. Today, the buyer, instead of being satisfied with a standard machine, must have one just a little different; he must be told what production he can obtain; he must have figured out for him how long it will take for the machine to pay for itself. The machine tool manufacturer, after having gone to a big expense to figure out everything requested, often learns to his dismay that his competitor has shaved off a few more seconds from the production time and secured the order.

To meet this competition, the machine tool builder decides that the design of his machine must be improved. He sets an engineering staff to work, exhaustive experiments are conducted, and no expense spared to cut down the production time. If successful in securing the order, he finds that the expense does not end with the shipment. A demonstrator is asked for and a high-grade mechanic is sent out to instruct operators. Railroad fares and hotel bills, not to speak of the wages of demonstrators, make a serious item of expense. When it is all over, the margin of profit, if any, is mighty small.

The Growing Cost of Service

The designer of today has transferred the skill of the operator to the machine, so that it is possible to employ less highly skilled mechanics. These men cannot always take care of simple troubles that may develop in the operation of present-day high-production machines, and the result is an increasing demand for the services of a skilled man from the factory.

Sometimes these calls for assistance are absolutely necessary and the expense incurred should justly be met by the machine tool builder. In the majority of cases, however, minor adjustments and changes that could easily have been taken care of by the buyer's own force are expected to be made by the machine tool builder's man. Does the buyer expect to pay the expense? He does not. He has the mistaken idea that the price he paid for the machine is high and that he is entitled to all the free service he can get, ignoring the fact that the machine is paying him a handsome profit on his investment.

What About Machine Tool Prices?

But are machine tool prices really high? Are machine tool builders making large profits? Decidedly no. Surveys of the financial conditions in the machine tool industry show that many plants, instead of making a large profit, operate without any profit at all. The one who profits is, apparently, the user. New machines frequently pay for themselves in a year or two, as compared with previous methods.

It is difficult to think of an investment as attractive as an investment in modern machine tools. They have made the automotive and kindred industries what they are today. Yet these industries are the ones that most frequently abuse the service privilege. In the selling of automobiles, only limited free service is given and the parts replacement period is strictly limited. Why should not machine tool builders take steps along similar lines, following the example of the automotive industry in restricting the amount of free service given?

In the development of a new machine, an experimental cost of from $25,000 to $50,000 is incurred. Trained engineers must be kept constantly at work to improve on the accepted designs of yesterday. The number of machines of any one model that may be sold is never very large, because new improvements make the best machines of a few years ago obsolete today. To recover the engineering and experimental cost, distributing it over a small number of machines, is the machine tool builder's most serious problem. Taking all these conditions into account, machine tool prices are not high, but rather unreasonably low.

The user, on the other hand, is never satisfied. He makes constant development expense necessary—playing one manufacturer against his competitor. As a result, a large number of machine tool builders are making less and less each year, while their machines earn more and more for the user. This condition cannot continue indefinitely.

Legitimate competition keeps an industry alive, but those engaged in the machine tool industry must obtain sufficient returns to be able to stay in business and continue the progressive work that has characterized this industry in the past. The user must be made to understand that he is buying production extremely cheap, and that the increasing engineering, experimental, and service costs make the costs of the machine tool builder much higher than in prewar days, even though the greater cost of materials, labor, and other manufacturing items is not considered.

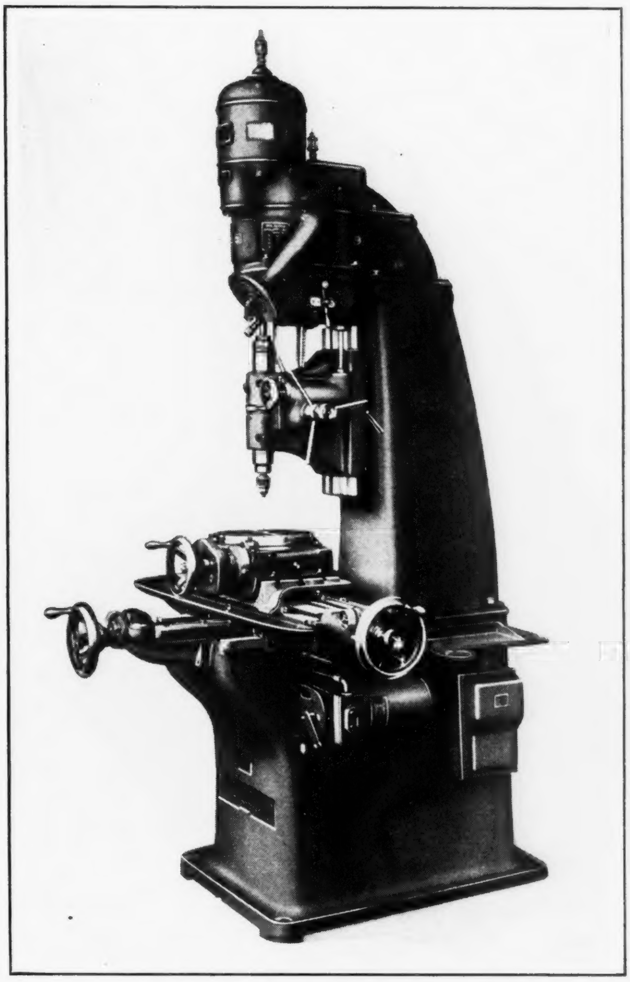
In fact, it is reasonable to assume that in years to come the idea that the machine tools of the present day were high in price will be looked upon with a smile, and, instead, men will wonder how it was possible to develop them and build them at the prices charged.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

PRATT & WHITNEY JIG BORER

A jig boring machine smaller than the No. 2 jig borer built by the Pratt & Whitney Co., Hartford, Conn., which was described in April, 1925, MACHINERY, has recently been developed by this company. The smaller machine represents a completely new design throughout. It is built in two sizes known as the No. 1 and the No. 1A, which are identical except for a difference in the maximum and minimum distances between the table surface and the spindle nose. These dimensions are 4 1/2 inches greater in the No. 1A machine than in the No. 1 machine. There is a difference also in the location of one control lever to compensate for the increased height of the No. 1A machine, which is here illustrated.



Pratt & Whitney Jig Boring Machine for Small Work

Like the No. 2 jig borer, the new machine is a combination of a precision vertical boring mill of the single-column type and a measuring machine for locating the work. A vertical variable-speed motor is built into the machine at the top of the column. This motor is arranged to drive the spindle either directly or through sliding back-gears. It is a simple matter to shift from one speed range to the other. The shifting lever has a circular motion and operates a spiral cam, which engages and disengages clutches that connect the back-gears or the direct drive. Changes from low to high speeds or vice versa are made without stopping the motor. Four motor speeds and the back-gears give a total of eight spindle speeds ranging from 132 to 1800 revolutions per minute, which makes the machine suitable for drilling, reaming, or boring operations.

The spindle quill construction is employed, the quill being carried in a head which is mounted on scraped ways on the column. Both the spindle head and the quill are balanced by counterweights inside the column. The spindle head is moved vertically by means of a rack and pinion mechanism operated through a handwheel on the left-hand side of the head. Binder bolts on either side of the head provide for locking it in position. A narrow guide maintains vertical alignment of the spindle head at all times.

There is a double worm and clutch device by means of which a power feed to the spindle quill is available either up or down, while a spoked handwheel on the right-hand side of the head furnishes a rapid hand traverse to the spindle quill. The round knob at the center of this handwheel may be used to engage either of the two worms for the up or down power feed, and this knob also has a neutral position. Slow-motion hand-feeding of the spindle quill can be obtained through the small handwheel on the front of the head. Power for the quill feed is taken from the motor that drives the spindle, and is delivered through back-gears which provide two power feeds of 0.002 and 0.005 inch per spindle revolution. These back-gears are controlled by a small lever on the column, and can be shifted while the machine is in motion.

The spindle is mounted in large bronze bearings inside the quill, and there is a ball thrust bearing at the lower end. The quill has 4 inches of travel in addition to the travel of the spindle head on the column face. This permits of boring the deepest holes for which the machine is intended without the necessity of resetting the head. Graduations on the face of the quill permit the boring of holes to a definite depth. The spindle nose is recessed to receive collets, and is threaded for a collet closing ring.

The measuring instruments and the general arrangement of the work-table and slides are the same as in the larger No. 2 jig boring machine. The work-table may be traversed in two directions by means of screws operated through handwheels, and each slide is equipped with a complete measuring device. The large handwheel on each screw is employed for rapidly traversing the table, while the small knob at the center of this handwheel dis-

engages the latter and throws in a small handwheel connected by a worm, to provide a slow motion for fine positioning.

The traversing screws have no connection with the measuring instruments, so that errors in the screws and wear or backlash do not affect the accuracy of the settings. The measuring instruments consist of end measures for even inches, an inside micrometer for fractions of an inch, and ten-thousandths inch dial indicators for determining the accuracy of the final settings. There is a small adjustable slide attached to the table which determines the zero position for any job. With this zero position determined and registered on the dial indicators, the table can be moved any desired amount and located accurately by means of the end measures and the inside micrometers.

The dial indicators always show the position of the table relative to the zero position and indicate instantly any minute change that may occur in the location of the table. Thus they form a continual check on a job. It is pointed out that this method of measuring, besides being simple and readily understood by mechanics, has the additional advantage of using the same instruments and the same set-up as the toolmaker uses to check the finished job on a surface plate. All driving parts of the machine are oiled automatically from reservoirs.

The illustration shows the machine equipped with a rotary table on the standard table, to permit precise circular indexing. Additional tools and appliances which are available to adapt the machine for many kinds of precision work include boring heads, boring tools, chucks, spotting tools, strap clamps, T-bolts, step blocks, parallel blocks, collets, drills, end-mills, reamers, etc. There is also a small universal dividing head and a tailstock, such as are used on Pratt & Whitney bench millers.

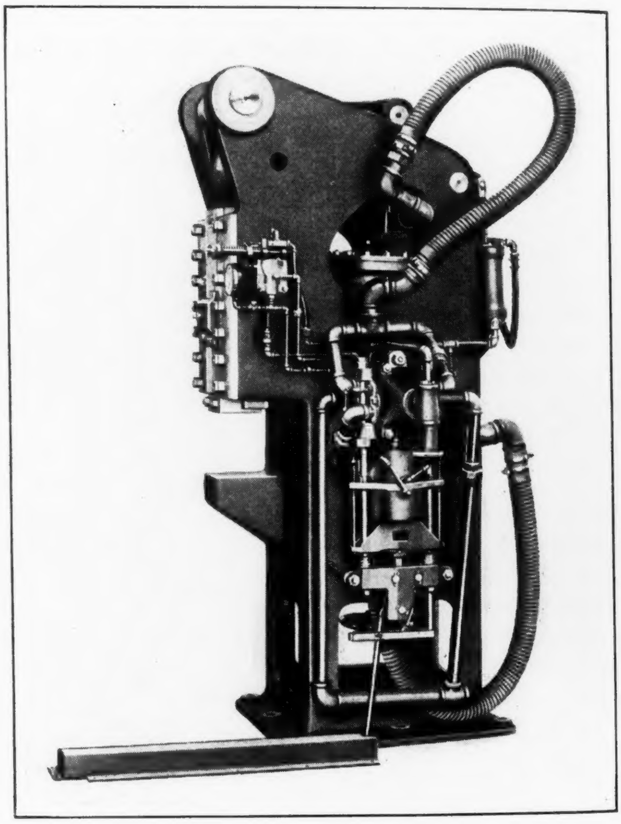
The net weight of the No. 1 jig borer is 2650 pounds, and of the No. 1A machine, 2800 pounds. Both machines occupy a floor space of 58 1/2 by 59 inches, and the working surface of the standard table measures 9 3/4 by 18 inches. The maximum longitudinal and transverse travels are 18 and 10 inches, respectively. In the No. 1 machine, the minimum and maximum distances from the top of the table to the spindle nose are 1 3/4 and 10 3/4 inches, respectively, while in the No. 1A machine, these distances are 6 1/4 and 15 1/4 inches. In both machines, the spindle head has a travel of 5 inches on the column, while the spindle quill has a travel of 4 inches. The distance from the center of the spindle to the face of the column is 9 1/4 inches.

HANNA HIGH-SPEED PNEUMATIC PRESS

Coining, squeezing, forming, upsetting, shallow-drawing, extruding, and punching operations can be performed in a high-speed pneumatic press which is being introduced on the market by the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Air equipment actuates the ram through the medium of the Hanna toggle and lever mechanism which is applied to the compression riveters built by the same company. The toggles close the gap between the dies with little air consumption, while the lever exerts a uniform pressure on the dies through a considerable portion of the ram stroke, regardless of variations in the thickness of work.

The stroke of the die or ram may be set through a wide range of lengths by adjusting a handwheel at the base of the press. The pressure exerted between the dies may be set to any amount from 20 per cent of the full press rating up to the maximum rating. This is accomplished by adjusting a pilot-valve regulating spring. The pressure for which the machine is set, which is exerted on the work, even though it varies in thickness, can be read direct from a gage that is always visible to the operator.

From thirty to forty stroke cycles can be made per minute as a result of the following features:



Hanna High-speed Pneumatic Press

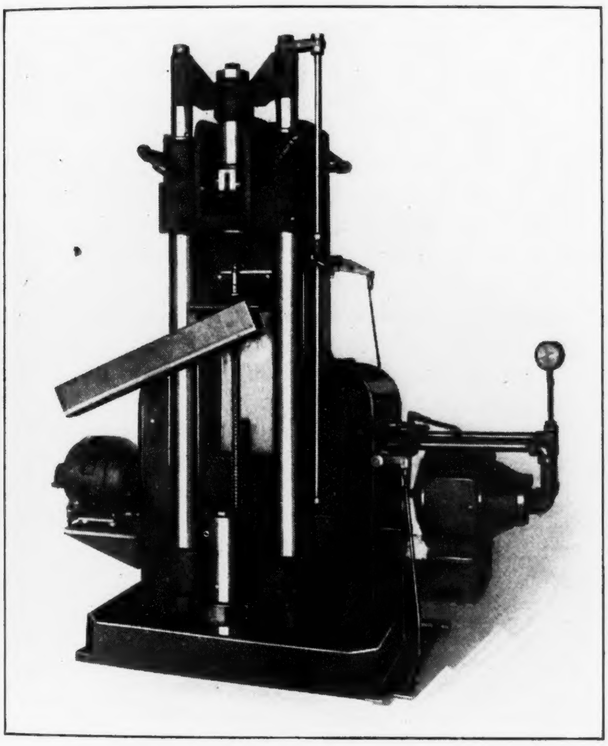
Shock-absorbing cushions at both ends of the piston stroke; an air counterbalance; an automatic reversal from the down stroke to the up stroke; and a foot-pedal for starting each stroke cycle, which merely requires a 1-inch movement of the operator's heel while standing naturally with his weight on both feet.

Only one die-stroke cycle results from each depression of the foot-pedal, even though it is held down. The pedal is guarded against accidental depression. An adjustment simplifies die settings and eliminates the need for shims less than 1/4 inch thick. This adjustment, together with the stroke adjustment, permits minimum air consumption. The return stroke is accomplished with less than one-tenth the air consumption required for the full-pressure working stroke. The press illustrated exerts a force of 150 tons between dies with an air pressure of 100 pounds per square inch. Presses of the same general construction are available in numerous styles and capacities.

AMERICAN VERTICAL HYDRAULIC BROACHING MACHINE

Broaches up to 50 inches long can be used in a vertical semi-automatic hydraulic broaching machine recently developed by the American Broach & Machine Co., Ann Arbor, Mich. This V-50 machine operates on the same principle as the horizontal hydraulic broaching machines built by the same company, employing broaches of the pull type. However, as the operator does not handle the broach, but merely feeds the work and controls the operation of the machine, the production of the vertical machine ranges from 100 to 150 per cent more than that of the horizontal machines.

Another feature of this machine, in addition to the speed of operation, is the small amount of floor space required. It is also pointed out that the broach and work, by virtue of their suspension during the broaching operation, are able readily to center themselves. Troubles sometimes met in broaching in a horizontal machine due to sagging of the broach and weight of the work are eliminated.



American Vertical Semi-automatic Hydraulic Broaching Machine

Two rams, which are actuated by two cylinders, operate the pull-head up and down. Cutting speeds from 0 to 30 feet per minute, and return speeds up to 80 feet per minute are available. The twin-cylinder construction, on which patents are pending, makes possible a machine of comparatively short working height. This height is 11 1/2 feet, the stroke being 50 inches. An oil tank having a capacity of fifty gallons is contained in the upper portion of the column. Relief valves, surge valves, and the general pipes of the pump are contained in the bottom of the column.

The control of the machine is such that the operator does not need to handle the broach at all. When the broach is in the starting position, the operator merely slips the work over the broach shank and presses a foot-treadle. This causes the lower cylinder to advance the broach until it automatically connects in the pull-head. Then, by applying a slight pressure on a second foot-treadle, the broach is made to continue through the work. At the end of the upward stroke, the work automatically drops on the angle table and slides down the chute into a tote pan, while the pull-head returns to the starting position, where the broach is automatically released ready for the next operation.

In the illustration, the machine is shown with the splash hood removed so as to expose the lower cylinder. This cylinder is provided with an extending arm in which there is a brass bushing which loosely fits the back pilot of the broach. When the broach is released at the end of an operation, it drops into this lower bushing. The machine is equipped with a lubricating pump.

Work up to 13 inches in diameter can be broached with this machine, and it has a capacity of twelve tons. A motor of 10 horsepower, running at 900 revolutions per minute, is required for driving purposes. The machine occupies a floor space of 4 by 6 feet and weighs 6400 pounds.

PFAUTER GEAR-HOBBING AND HOB-SHARPENING MACHINES

A Pfauter manufacturing type of gear-hobbing machine, designed primarily for producing spur gears in automobile plants, is being placed on the market by the O. Zernickow Co., 21 Park Row, New York City. This machine will hob chrome-nickel steel spur gears up to 12 inches diameter, with a maximum of 5 diametral pitch. The maximum hobbing width is 8 inches. By limiting the machine to the production of spur gears of sizes used in automobiles, features important in quantity production have been obtained, such as simplified control and rapid operation. This machine is illustrated in Figs. 1, 2, and 4. A hob sharpening machine recently brought out by the same company, is shown in Fig. 3.

The main drive of the hobbing machine is through a direct-coupled motor bolted to a bracket on the bed of the machine, which is conveniently started and stopped from the operator's position. The hob is driven through spur and bevel gearing and a splined shaft. An internal-tooth gear cut in one of two flywheels in the drive to the hob spindle constitutes the final drive to this spindle. Hob speeds of 62, 89, 125, and 175 revolutions per minute are obtainable through change-gears, the infrequency of hob-speed changes on a machine intended for quantity production eliminating the necessity of a gear-box.

The adjustable hob spindle and the hob driving spindle are located one above the other on the hobbing head. Each of these spindles carries a large flywheel at its outer end for equalizing the torque on the hob spindle. The hobbing head can be swiveled 5 degrees each side of the horizontal, to suit the lead angle of the hob. The hobbing saddle slides on V-ways on the upright and is provided with means for adjustment. The weight of the hobbing saddle is balanced, and the driving shaft is in tension. The dividing gear drive runs in an oil bath, and consists of a worm-wheel and a worm that is adjustable axially and radially.

Hob feeds are available in many steps from 0.028 inch to 0.236 inch, without the use of any change-gears. Feeds may be instantly changed, even while the machine is running, by operating a single lever. Fig. 4 shows a view of the feed mechanism. The feed-change lever is seen at *A* and the feed starting and stopping lever at *B*.

At the end of a cut, the hobbing saddle is returned automatically to its starting position by a separate motor located in the base of the machine. The reversing positions for this traverse are controlled by adjustable stops, according to the nature of the work. This quick power-traverse of the hob saddle can also be effected at any time by operating a switch conveniently located. About seven gallons of coolant are delivered per minute to the hob by a pump.

The work is mounted conveniently on a vertical arbor, which is supported by an arm solidly connected with the machine column. This arbor support gives a rectangular machine design, which is said to withstand all stresses without distortion. Interchangeable work-arbors enable one arbor to be loaded ready for substitution in the machine as soon as the gears on another arbor are completed. The loading time is thus reduced to a few seconds.

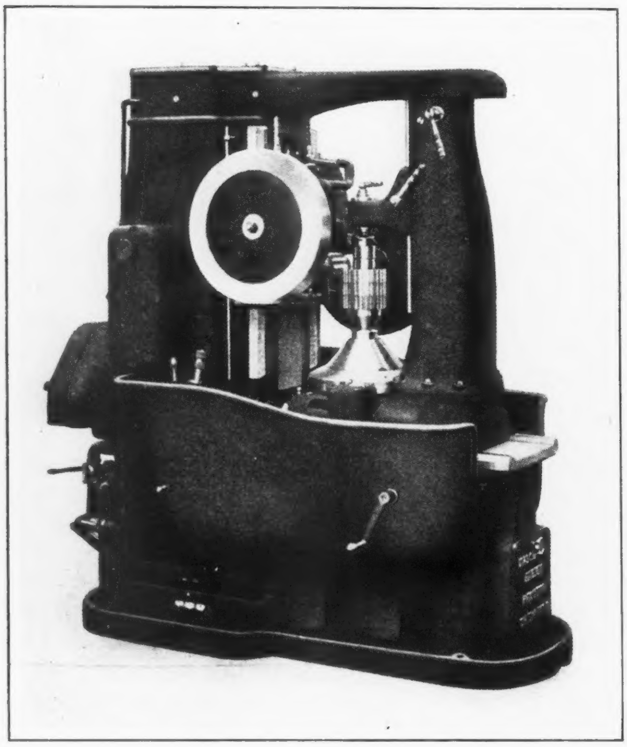


Fig. 1. Pfauter Spur-gear Hobbing Machine Designed for Quantity Production

All controls are within easy reach of the attendant, and the operation of the machine is simple. After the stops for the automatic travel of the hobbing saddle have been positioned and the table set for the correct depth of tooth, the table carriage is locked in position on the bed by means of a single handle. These settings are necessary only when changing the machine to cut a different gear and are seldom required in mass production. In changing work in the ordinary operation of the machine, it is only necessary to release the arm of the work-arbor support, replace the work-arbor with another loaded with blanks, retighten the support arm, and engage the feed. All main shafts of the machine run in ring oiling bearings, while other important bearings are furnished with oil by a pump. The net weight of the machine is about 5300 pounds.

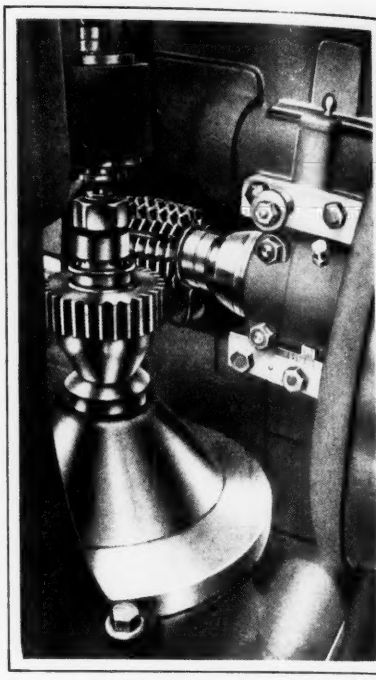


Fig. 2. Close-up View of the Work-arbor and Hob Spindle

The hob sharpening machine shown in Fig. 3 resembles the Pfauter sharpening machine described in May, 1926, MACHINERY, but it is smaller in size and embodies several important differences in design. It is intended for sharpening hobs up to 6 5/16 inches diameter. This new machine is built in semi-automatic and full-automatic models. In the semi-automatic model, indexing from one flute to the next is accomplished by hand, and the feed of the hob or cutter toward the wheel after each complete revolution of the work is also accomplished manually. The full-automatic machine indexes automatically from one flute to the next and also feeds the hob or cutter automatically toward the grinding wheel. One man can attend to several of these full-automatic machines. Both types of machines can be employed for grinding

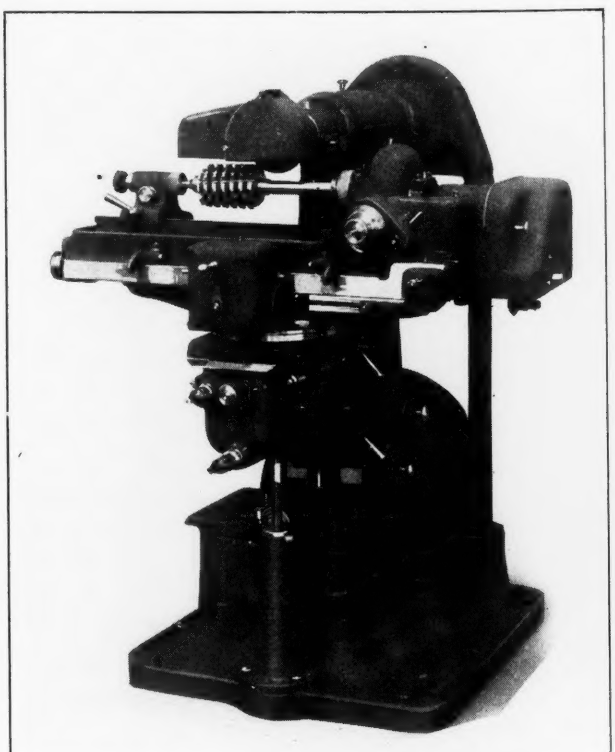


Fig. 3. Hob Sharpening Machine Built in Semi-automatic and Full-automatic Models

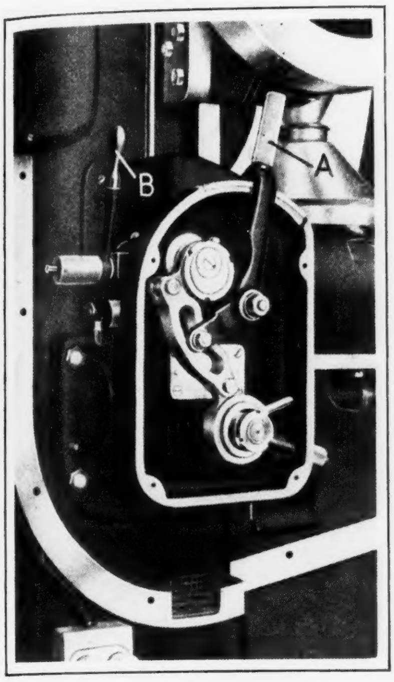


Fig. 4. Mechanism which Provides Various Feeds without the Use of Change-gears

milling cutters, reamers,taps,etc as well as hobs.

In the new machine, a fan is attached directly to the grinding spindle opposite the grinding wheel, so as to suck all grinding dust into a water tank in the base. The driving motor is totally enclosed in the base. A motor of 2 horsepower running at about 1000 revolutions per minute is employed. The maximum automatic longitudinal movement of the table is 13 3/16 inches; the cross adjustment of the table, 4 3/4 inches; and the vertical adjustment of the table, 5 7/8 inches. The table may be adjusted 35 degrees each side of parallel.

CURRAN PORTABLE CUTTING-TOOL LUBRICATOR

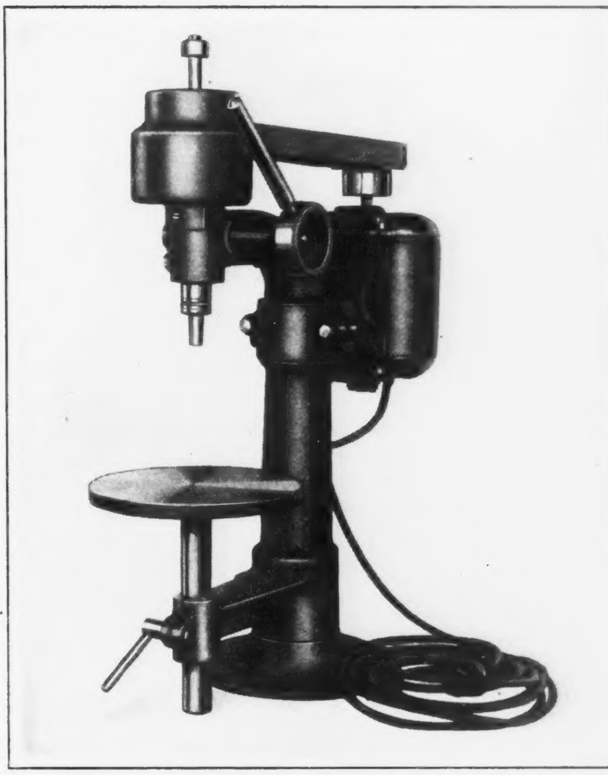
It is common practice on machines not equipped with means for automatically supplying lubricant to the cutter or work to apply the lubricant by means of a paint brush or an oil-can. This practice usually results in intermittent operation, because the operator must remove one hand from a control lever or from the work to apply the lubricant.

Curran Portable Cutting-tool Lubricator

With a view to permitting an operator to supply lubricant to tools on machines of this kind without interrupting the operation, the Curran Machine Works, 159 Newtown Road, Long Island City, N. Y., has placed on the market a portable equipment by means of which lubricant can be supplied by depressing the foot-treadle of a pump, as shown in the illustration. A quick-acting clamp which can be attached to a table or another part of the machine is furnished to direct the delivery pipe toward the cutter or work. This equipment is applicable to drilling machines, lathes, and other types of machine tools. It is shown being used in a tapping operation.

BURKE BENCH DRILLING MACHINE

A 10-inch sensitive bench drilling machine driven by a vertical motor has been added to the line of drilling machines built by the Burke Machine Tool



Burke Bench Drilling Machine

Co., 516 Sandusky St., Conneaut, Ohio. The motor of this No. 222 machine is fastened to a bracket which also acts as a belt tightener. This bracket is mounted on the column of the machine and has as slight an overhang as possible, so as to give a well balanced and compact machine. The motor carries a two-step cone pulley and drives through a 1-inch endless belt to a top cone pulley of the two-speed double-flanged type.

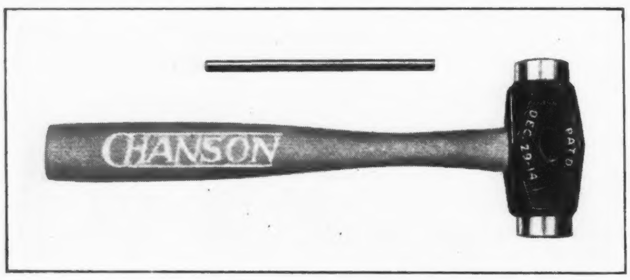
The spindle is made to fit either Jacobs or Almond chucks. It is counterbalanced through the pinion, and the pinion has an unusually long bearing. A four-position handwheel is provided. Besides the round table, a square table with an oil pocket can be furnished, and V-blocks and centers.

Some of the specifications of the machine are as follows: Greatest distance from spindle to table,

9 3/4 inches; vertical movement of spindle, 2 1/2 inches; vertical movement of table, 7 inches; distance from center of spindle to frame, 5 1/8 inches; maximum drilling capacity, 3/8 inch; spindle speeds, 1150 and 2600 revolutions per minute; and weight of machine, 80 pounds.

CHANSON SOFT-FACED HAMMER

A hammer having a steel body that may be provided with copper, babbitt, and steel plugs or faces, has been placed on the market in five sizes by the Chanson Division of the Illinois Iron & Bolt Co., Carpentersville, Ill. The different sizes of this hammer have handle lengths ranging from 10 to 24 inches, while their weights range from 3/4 to 8 pounds. The plugs are machined for a press fit in the steel body. They can be removed with ease for replacement purposes by applying a drift pin.

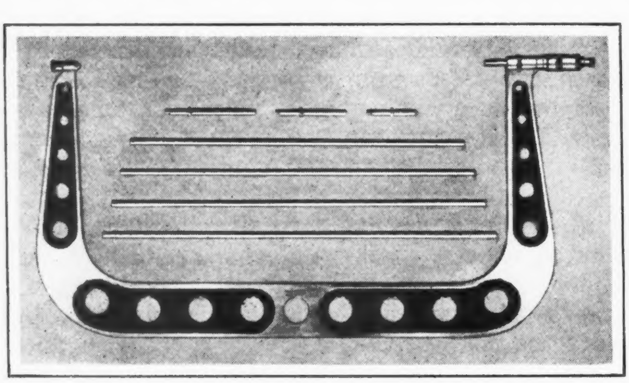


Chanson Hammer with Steel Body and Renewable Copper or Steel Faces

BROWN & SHARPE MICROMETERS

Three large micrometers, having a combined range equal to that of twelve ordinary micrometers of 1-inch range, have recently been added to the products of the Brown & Sharpe Mfg. Co., Providence, R. I. Micrometer No. 90 has a range of from 12 to 16 inches; No. 91, from 16 to 20 inches; and No. 92, from 20 to 24 inches. Each micrometer is graduated in thousandths of an inch, and its range of 4 inches is obtained by means of four interchangeable anvils of different lengths.

The anvils can be quickly changed and are held in place positively by means of a knurled nut. The anvils cannot revolve, but remain in one position in accurate alignment with the spindle. Each anvil has means of adjustment for wear. Clamp rings are furnished for the micrometers. The micrometers can also be obtained graduated according to the metric system.



Brown & Sharpe Micrometer having a Measuring Range of 4 Inches

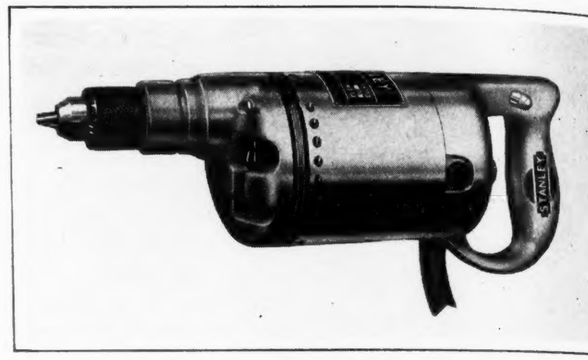


Fig. 1. Stanley Portable Electric Drill

STANLEY PORTABLE ELECTRIC DRILLS

Portable electric drills have recently been added to the products of the Stanley Works, New Britain, Conn. These drills are made in the following sizes: 1/4 inch, standard duty; 1/4 inch, heavy duty (shown in Fig. 1); and 1/2 inch, heavy duty (shown in Fig. 2). They weigh 6 1/2, 8, and 17 1/2 pounds, respectively. In the design of these drills, special attention has been given to providing adequate ventilation. A fan mounted on the armature shaft of each drill draws air into the frame at the rear of the drill to cool the brushes and commutator. By means of baffles, this air passes between the armature and field and out through tangential holes in the housing.

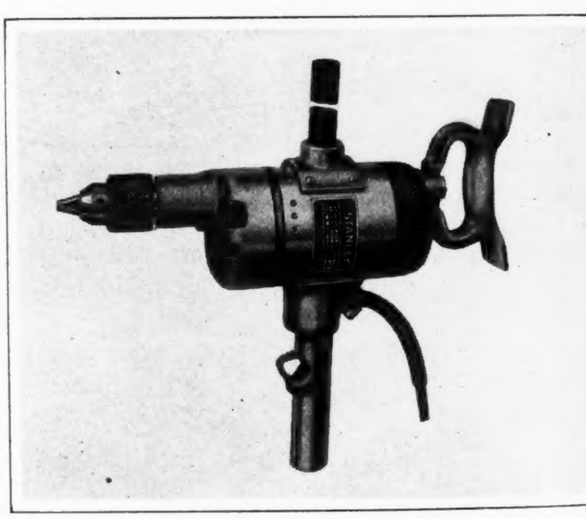
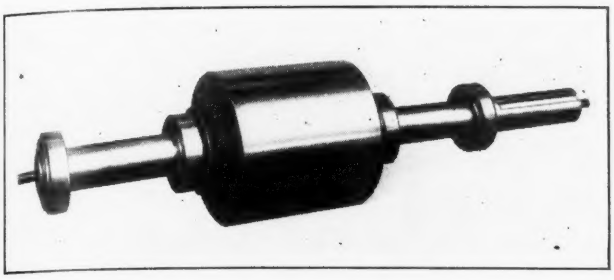


Fig. 2. Stanley 1/2-inch Heavy-duty Drill

The motor of each drill can be readily observed while running, and the commutator and brushes can be easily cleaned. Ball bearings set in steel jackets molded into the aluminum casting, are used on both ends of the armature shaft, with the exception of the small drill size in which there is a ball bearing at the outer end only of the armature shaft. The switch is of a standard quick make and break type, and is so placed that it can be operated to start or stop the motor without releasing the firm grip of the fingers on the handle.

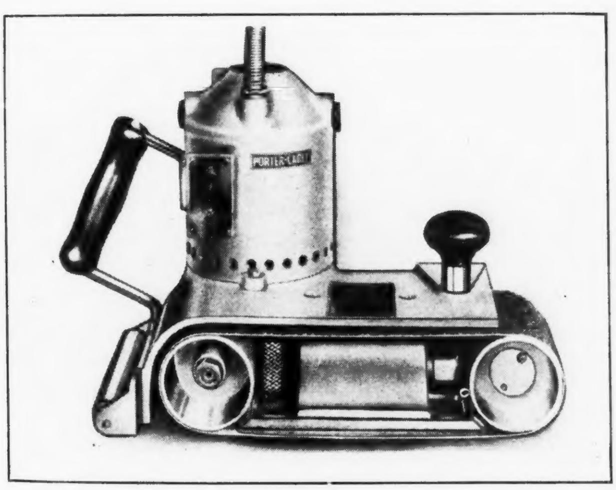
Radial ball thrust bearings are provided on all chuck spindles in addition to long bronze sleeves. Three-jaw chucks are provided. The chuck key of all drills is securely fastened in a recess in the drill housing, but may be instantly released from this recess for use. The gears are made from alloy steel, heat-treated, and run in grease. Stands of various designs are made for use with the drills.



Roll Assembly for Chambersburg Drop-hammer

CHAMBERSBURG BOARD DROP-HAMMERS WITH ROLLER-BEARING HEADS

The rolls of board drop-hammers built by the Chambersburg Engineering Co., Chambersburg, Pa., may now be equipped with roller bearings, as shown in the accompanying illustration. It is mentioned by the company that tests conducted over a period of one year have shown a number of advantages derived from the use of roller bearings, including a considerable saving in power, better maintenance of alignment, and the elimination of operation interruptions for oiling and changing bushings. The packing of the roller bearings insures good lubrication over long periods of time without oil reaching the boards. Chambersburg board drop-hammers will be built with the roller bearings or with the old type bearings, as desired.



Porter-Cable Hand Sander and Grinder for Wood and Metal

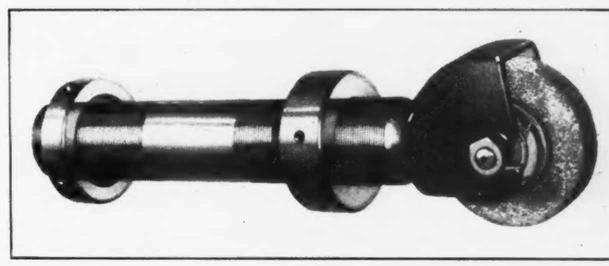
PORTER-CABLE HEAVY-DUTY HAND SANDER

Metal surfaces may be ground or polished and wooden surfaces sanded with a "Super Take-About" portable belt sander recently placed on the market by the Porter-Cable Machine Co., Syracuse, N. Y. This equipment is somewhat similar to the sander described in November, 1926, MACHINERY, but is designed for heavier service. It is equipped with a new type compound-wound air-cooled motor, which shows little rise in temperature after continuous use. It is of 1 horsepower capacity, and drives a 4-inch belt at the rate of 2000 feet per minute. The motor is of the universal type for operation on alternating or direct current. Motors for current of from 32 to 250 volts can be furnished, but 110-volt motors are generally supplied.

Flexible pads can be provided to permit the sanding of slightly curved surfaces. Belts can be changed in a fraction of a minute, and the correct tension on the belts is automatically maintained. This sander has pulleys 2 3/4 inches in diameter, and the weight of the entire equipment is 22 pounds.

ROSS TRUING TOOL FOR CINCINNATI CENTERLESS GRINDERS

A truing tool designed for application to Cincinnati centerless grinding machines is being introduced to the trade by the Ross Mfg. Co., 2196 Clarkwood Road, Cleveland, Ohio. This truing unit employs an abrasive wheel 5 inches in diameter, which turns on a grit-sealed ball-bearing spindle



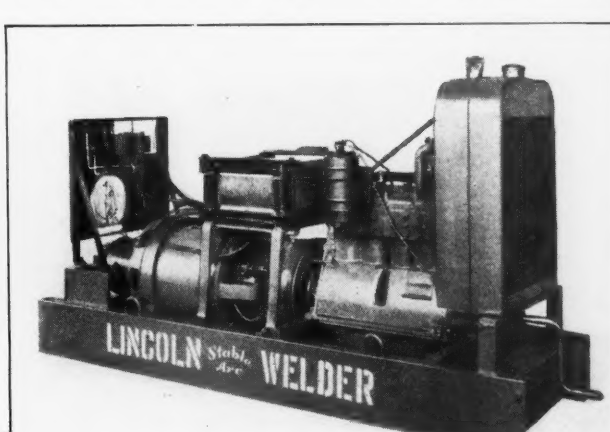
Ross Truing Wheel for Cincinnati Centerless Grinders

assembly. The shank of the tool fits into the slide of the grinding machine and is keyed to the truing slide, holding the truing wheel at a 10-degree shearing angle. The tool is fed into the grinding wheel by means of two threaded collars on the shank, which are adjusted by spanner wrenches.

This tool can be applied to Nos. 2, 3, and 4 Cincinnati centerless grinding machines by substituting a new guard, which is supplied by the manufacturer of the machines. This guard provides the necessary clearance for the 5-inch wheel. It is claimed that the truing tool eliminates truing marks or high spots on grinding wheels and work.

LINCOLN GAS-ENGINE DRIVEN WELDER

A "Stable-Arc" welder known as the S-1960 model, which is intended particularly for use in construction work, has been brought out by the Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio. This new unit has a rating of 200 amperes according to the standards of the National Electrical Manufacturers' Association, with a current range for welding duty of from 50 to 300 amperes. It operates at a speed of 1500



Lincoln Gas-engine Driven Welder for Construction Service

revolutions per minute. Motive power is provided by a Continental four-cylinder type H-9 engine.

The welding generator and engine are mounted on a structural welded steel base, providing maximum rigidity with minimum weight. The generator is also constructed of steel, which not only gives light weight, but also reduces the possibility of breakage in the field. The magnetic circuit of the generator is of laminated steel construction which increases the stability of the arc. This feature is particularly desirable in the work for which the unit was developed, because welding must frequently be done in a vertical plane and overhead. A steel switchboard, supplied in place of the usual slate or composition board, still further reduces the possibility of damaging the equipment in service.

This unit is not designed to replace the heavy-duty engine-driven equipment built by the same company, but to provide a lighter unit. It weighs 1580 pounds, and is 76 inches long by 25 inches wide.

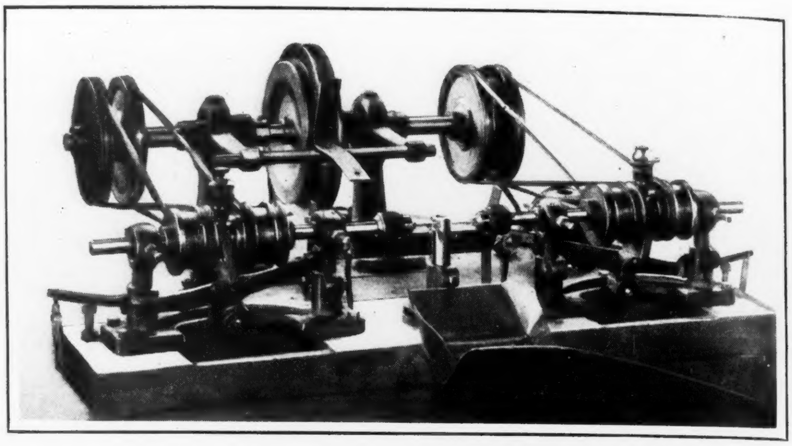


Fig. 2. Bench-type Horizontal Two-spindle Drilling and Tapping Machine

NIAGARA COMBINATION BENCH MACHINE

Turning, wiring, and burring operations can be performed on sheet metal by means of a No. 147-C heavy combination bench machine recently placed on the market by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. This machine closely follows the design of the smaller No. 131-C machine described in November, 1927, MACHINERY. The new machine is arranged with back-gearing, and will handle soft steel up to No. 18 gage. It can be furnished with pairs of burring, turning, and wiring faces which are made of steel, hardened and polished. These faces are easily removed or interchanged.

MAHAN DRILLING AND TAPPING MACHINES

Convenient universal application and high-speed operation are the principal advantages claimed for the single-spindle and two-spindle drilling and tapping machines now being introduced on the market by C. B. Mahan, 162 Longview Terrace, Rochester, N. Y. These machines are so designed that they can be quickly set up for various jobs by unskilled labor. Taps are run at speeds up to 2000 revolutions per minute.

Differences in the tap leads and cutting speeds of various operations are controlled by means of a spring, which considerably facilitates the use of the machine for different kinds of work. The horizontal design is said to simplify jig constructions, eliminate trouble from dirt and chips, and avoid difficulties from weight and backlash of the spindles. The machines can be quickly set to tap to definite depths, the taps automatically reversing as the operation is completed.

Fig. 1 shows a No. 1 floor-type two-spindle machine which, in addition to being used for drilling and tapping, can also be employed for external threading, counterboring, countersinking, screw-inserting, rivet-heading and other operations. The chucking arrangement is automatic, the work being gripped before it is engaged by the drills or taps. Fig. 2 illustrates a No. 2 bench-type machine similar in design to that shown in Fig. 1, but smaller and faster. In using No. 4 taps with thirty-six threads per inch, holes have been tapped in this machine to a blind bottom at the rate of 3400 holes per hour.

One of the spindles of these machines may be equipped with a drill and the other with a tap, to provide for drilling a hole with one spindle and tapping the same hole with the opposite spindle. Drilling and counterboring or similar combined operations can be performed by providing the opposing spindles with different tools. Die-heads have been used for cutting threads on the ends of small cranks at the rate of 1500 cranks per hour. Two holes can be drilled very close together in parts in one operation.

A No. 3 single-spindle bench type of machine is also built which, in reality, comprises one unit of a double-spindle machine.

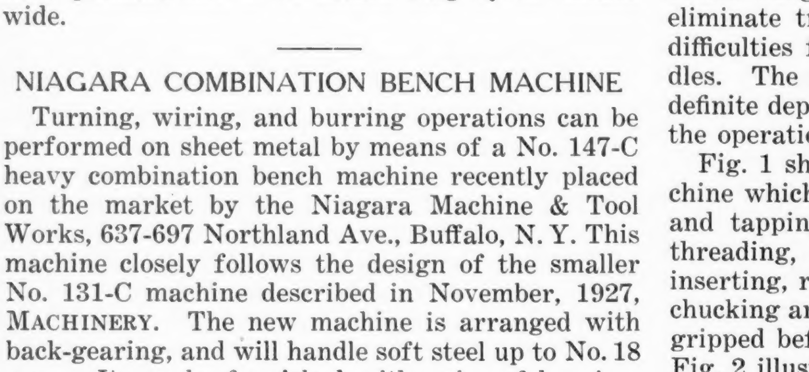


Fig. 1. Mahan Floor-type Horizontal Drilling and Tapping Machine

GENERAL ELECTRIC SOLENOID BRAKES

A complete line of solenoid brakes for operation on alternating and direct current is being placed on the market by the General Electric Co.,

Schenectady, N. Y. These brakes are especially designed for severe service in connection with mill, crane, and hoist motors.

One of the particular features of construction is a spring setting device. The brake mechanism is held in the "off" position by a coil and plunger; when power is applied to the motor, this coil is energized and the brake is released. When the power is shut off, the spring setting device forces the mechanism into the closed or braking position.

Both alternating- and direct-current brakes use the same mechanism and frame, the solenoids being interchangeable. The brakes, being spring-set, can be mounted in any position. Brake wheels of unusually small diameter are used.

BLACK & DECKER ELECTRIC GLUE POT

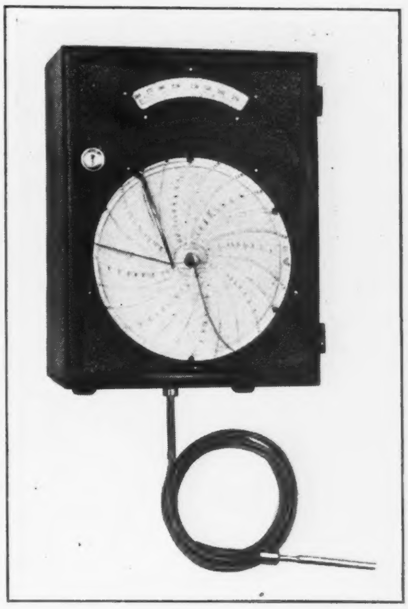
An electric glue pot designed to be carried to a job, instead of having to take the work to the pot, is a recent product of the Black & Decker Mfg. Co., Towson, Md. It is built for operation on alternating current of 110 or 220 volts and keeps the glue at a constant temperature of 150 degrees F. The heating element is a "Nichrome" ribbon, provided with mica plates and a thermostatic control. The glue container has a two-quart capacity. It is an aluminum casting and is machined to fit a gray iron receptacle which conserves the heat. The heating element is sealed with asbestos to eliminate fire hazard, short circuits, etc. The sides of the pot are sloped, so as to minimize spillage, and an iron wiper extends across the center of the glue container to prevent waste from drippage.

Black & Decker Electric Glue Pot

BRISTOL RECORDER CONTROLLER

A model 267 recorder and contacting controller now being introduced to the trade by the Bristol Co., Waterbury, Conn., combines in one case the features of a recorder and a thermometer controller. This gives a more compact outfit than would be possible with separate instruments. The equipment consists of a single-pen recording system, with a controller system and scale mounted directly above it. The recording pen and the moving contact of the controller are actuated by separate pressure elements that are alike in construction. These elements are connected through a capillary tube to the sensitive bulb. With this arrangement, the record is not impaired by a retarding effect of the controller and the recorder draws a correct record both above and below the control point.

This recorder controller is arranged for a contact capacity of 1000 watts by equipping it with self-contained automatic switches. Terminals are supplied for making easy connections to line and control apparatus, and all internal circuits are well insulated. To use the instrument, it is only necessary to set the control to the desired temperature by moving the index pointer over the scale.



Bristol Recorder and Contacting Controller in One Case

Zero adjusters are furnished for both the recorder and the controller pressure elements. They are not easily tampered with, because they can be moved only after being unlocked by a screwdriver. The large current-carrying capacity of this controller makes it suitable for many applications without the use of relays. Bristol motor-operated and solenoid controller valves may be connected directly to the terminal.

ZEISS PROJECTION "OPTIMETER"

A projection "Optimeter" has recently been added to the line of Carl Zeiss optical measuring tools sold in this country by the George Scherr Co., 144 Liberty St., New York City. In comparison with the standard "Optimeter" which was described in October, 1924, MACHINERY, the principal feature of the new instrument is the convenient means of reading the scale by both eyes instead of through a microscope. The improvement will be apparent by referring to Fig. 2.

The optical tube has been altered to permit a lamp holder as well as a screen attachment to be fitted to it, as shown in Fig. 1. The image of the scale as it is formed in the ocular is projected on the screen through a set of prisms.

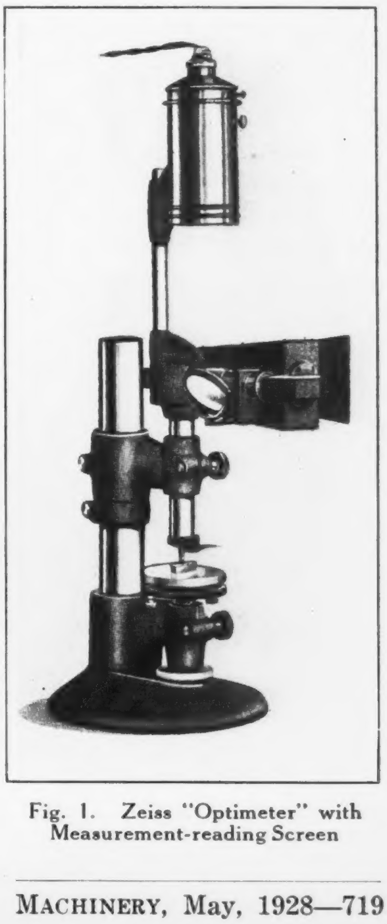


Fig. 1. Zeiss "Optimeter" with Measurement-reading Screen

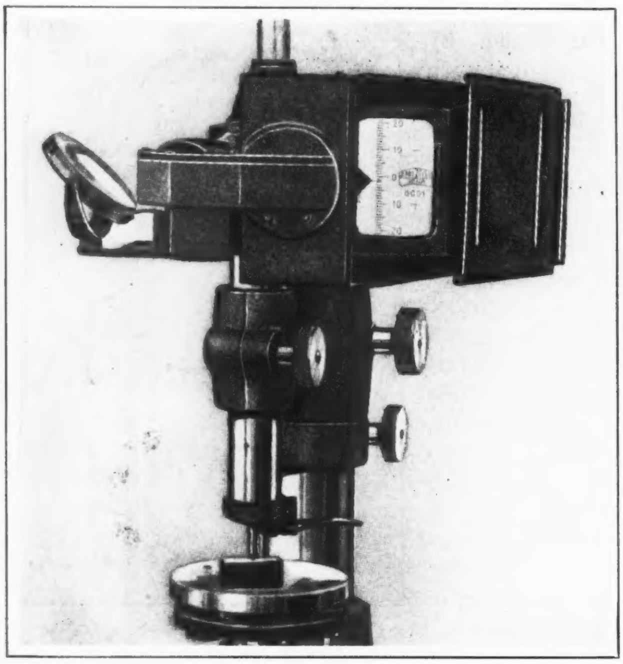


Fig. 2. Close-up View of the "Optimeter" Measurement-reading Screen

Reading of measurements from the screen facilitates the use of the instrument without impairing its accuracy, for the transfer of the image is obtained by purely optical means. This quick-reading feature lends the "Optimeter" more readily to mass inspection than in the past, and two or more persons can take readings at the same time. The application of the "Optimeter" tube to special fixtures may be accomplished as before.

Other improvements embodied in the new design are a table with a serrated surface and an increased scale range to plus and minus 0.005 inch. The scale is graduated to 0.00005 inch as in the past. The projector is also available for horizontal and inside "Optimeters."

WESTINGHOUSE SINGLE-OPERATOR ARC WELDER

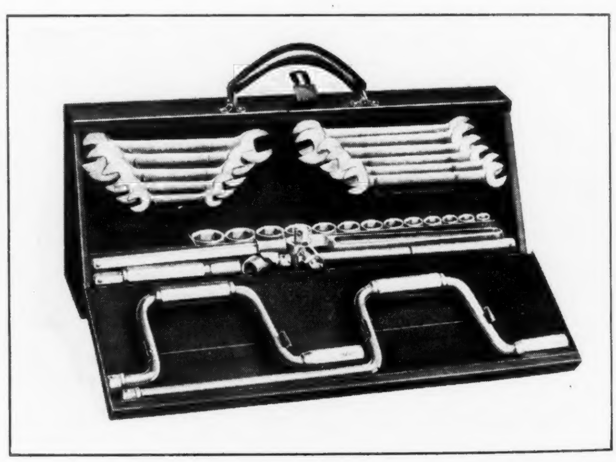
A new 200-ampere single-operator arc welding set designed to meet the requirements of both the shop and field, has recently been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This set is started by connecting directly across the line through a "Linestarter" and "Linestart" motor. Starting and stopping are accomplished by simply operating a push-button. A single rheostat varies the arc current over the entire welding range from 60 to 300 amperes, in steps of 5 amperes.

Westinghouse 200-ampere Arc Welding Set

The motor-generator and control equipment are assembled in an enclosed frame as illustrated, while the exciter, which is overhung from the motor end, is fastened to the unit frame. This construction guards the operator against injury and protects the set from dirt and falling objects. The exciter permits high-speed welding and results in a machine having a generator voltage that responds to any changes in arc conditions, thus tending to maintain a constant rate of electrode fusion. The rating of the unit conforms to the standard rating of the National Electrical Manufacturers' Association. The motor is wound for 220 or 440 volts, and is assembled with the necessary connections for operation from a three-phase 60-cycle circuit.

WILLIAMS-HUSKY COMBINATION WRENCH SETS

A recent sales arrangement made between J. H. Williams & Co., Buffalo, N. Y., and the Husky Wrench Co., Milwaukee, Wis., enables each company to merchandise open-end or socket wrenches, as the case may be, in combination with its own wrenches. This arrangement is made for sales purposes only and is limited to the items which constitute the sets.



Williams-Husky Combination Wrench Set

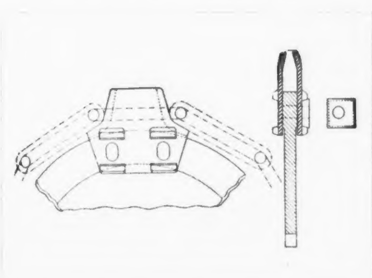
The illustration shows a typical wrench set made available through this selling arrangement. This No, 642 kit includes five Williams "Superrenches" of either the engineer's pattern, seen at the left in the body of the case, or the obstruction pattern, described in October, 1927, MACHINERY, with openings from 3/8 to 7/8 inch; six tappet-pattern "Superrenches," such as seen at the right in the body of the case, with openings from 1/2 to 7/8 inch; thirteen "Husky" chrome-alloy steel hexagon sockets from 7/16 to 1 inch; and seven wrench handles for these sockets. There is space in the kit for extra tools, such as hammers, hacksaws, and files. This set is intended especially for garage mechanics. The case is made of No. 20 gage automobile-body steel.

A No. 321 Williams-Husky "Economy" wrench set is also being introduced on the market. This set comprises a smaller assortment than the No. 642 kit, but it meets everyday needs. It includes five Williams "Superrenches" of either the engineer's or obstruction pattern, with openings ranging from 3/8 to 7/8 inch; ten Husky hexagon sockets ranging from 7/16 to 7/8 inch; and six socket wrench handles.

SPROCKETS WITH EXPANSIBLE TEETH

Sprockets having teeth that may be adjusted radially from time to time to compensate for wear and consequent elongation of chain links are a recent development of the Union Chain & Mfg. Co., Sandusky, Ohio. Chain elongation, though seemingly slight in any one link, is multiplied by the number of links in engagement with the sprocket, and often causes a misfit between the chain and sprocket that results in jerky and noisy action.

As shown in the illustration, both sides of the body rim of the new sprocket are machined to insure true running and to receive the teeth, which straddle the rim and are firmly clamped to it. Turned bolts, which are closely fitted in the rim, project through elongated holes in the teeth, the latter being secured relative to the pitch diameter by means of square beveled-edge adjusting blocks which are fitted between lugs on the teeth. A hole is jig-drilled through the blocks at a point four different distances from the various edges. Thus, when the blocks are mounted on the bolts, the pitch diameter of the sprocket is governed by the arrangement of the blocks.



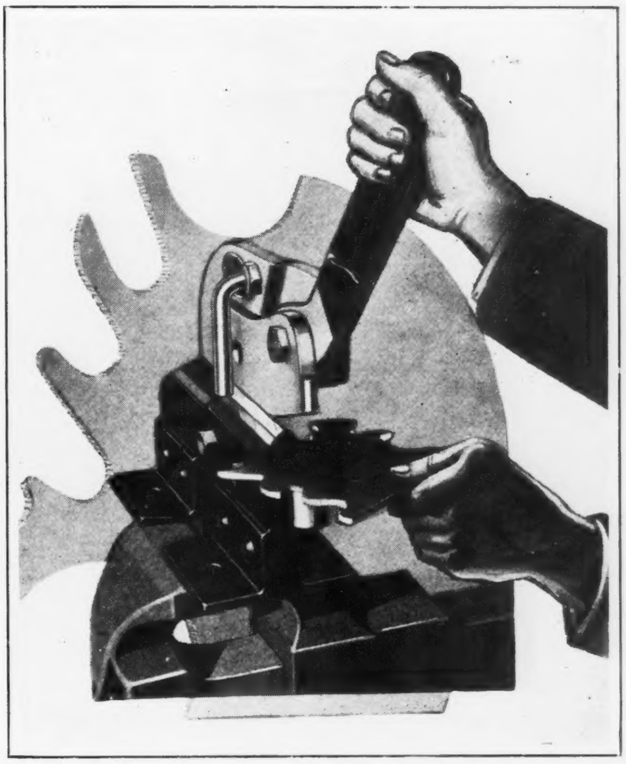
Expansible Tooth of Union Sprockets

When received by the user, each sprocket is correctly assembled to fit the chain properly. After the chain has elongated beyond a correct fit on the sprocket, the nuts are released and the eccentric blocks quickly readjusted so as to expand the teeth to the next larger pitch diameter provided for. As a rule, adjustments are not required often.

COMBINATION SHEAR AND NIBBLING MACHINE

A portable hand-operated shear and nibbling machine known as the "Handnib" has been brought out by the National Machine Tool Co., 1536 Clark St., Racine, Wis. This machine can be gripped in any vise, and need not be mounted on a bench. A clamping arrangement consisting of a taper latch adjusts itself automatically to any vise. When a bench mounting is desired, this latch may be swung out of the way.

The machine is provided with a concave knife that will shear any curved line, while a semicircular punch will cut out metal in corners ordinarily hard to get at. Short, quick strokes are recommended when cutting to outlines. The construction of the equipment is such that the sheared portion of metal will clear the machine. Flat stock up to 1/8 inch thick and round bars up to 5/16 inch in diameter can be sheared. The weight of the equipment is 13 pounds.



"Handnib"—a Combined Shear and Nibbling Machine

HISEY IMPROVED DRILLS AND GRINDER

Improved 1/4- and 1/2-inch portable electric drills and a 6-inch 1/4-horsepower bench grinder have been added to the line of the Hisey-Wolf Machine Co., Cincinnati, Ohio. The appearance of the 1/4-inch drill closely follows that of the drill described in March, 1927, MACHINERY, while the 1/2-inch drill is shown in Fig. 1. The bench grinder is illustrated in Fig. 2.

The motors of all these new developments are mounted in ball bearings fitted in such a way as to eliminate the slip and creeping action sometimes

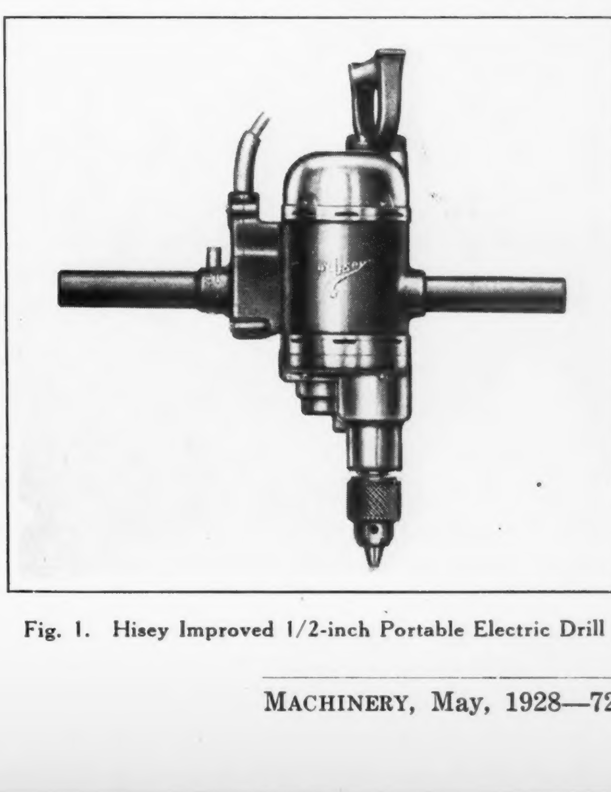


Fig. 1. Hisey Improved 1/2-inch Portable Electric Drill

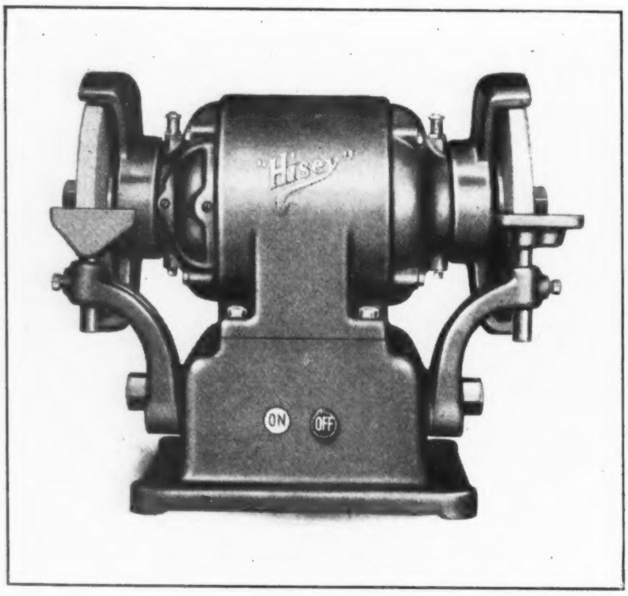


Fig. 2. Hisey 1/4-horsepower Bench Grinder

detrimental to motors and other mechanical parts. The spindles are hardened and ground where necessary. Brush-holders with an adjustable spring-tension feature are mounted as a separate unit on a bakelite yoke. This provision permits brush adjustment when necessary.

COMBINATION BLOWER AND SUCTION DEVICE

An "Ideal" combination blower and suction device which may be employed for removing dust and dirt from machines, stock bins, girders, etc., or for drying damp machines, tools, electrical apparatus, or work, is a recent development of the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This blower and suction equipment is suspended

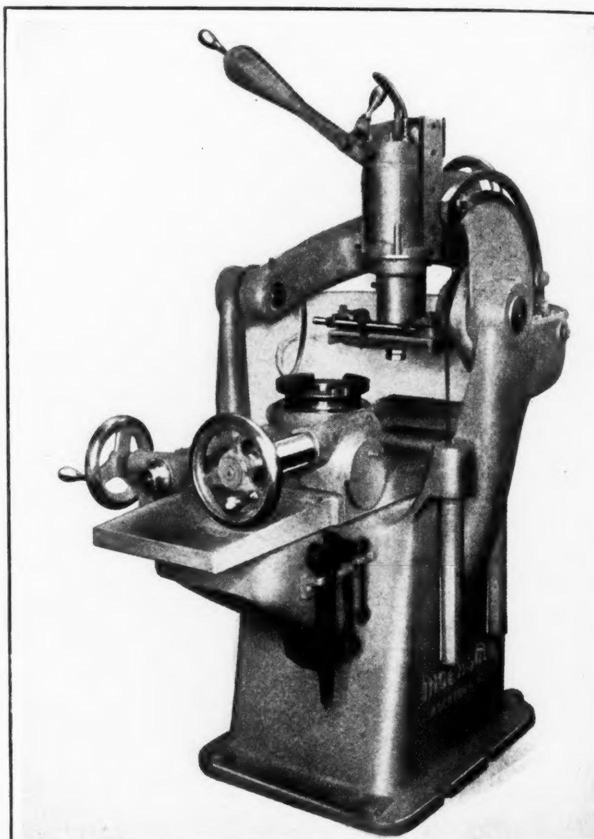
Combination Blower and Suction Device Designed for Machine Shop Use

from the shoulder of the user by means of a strap, and is conveniently carried about with him. It is driven from ordinary lighting circuits.

The equipment is especially suitable in connection with the grinding of commutators and slip rings, as it eliminates the possibility of dust entering into the windings. The dust bag may be emptied without removing it from the cleaner by simply taking off the clip at the bottom. A spray tank can also be supplied for spraying disinfectants, etc.

INGERSOLL IMPROVED CUTTER GRINDER

A motor-driven milling cutter grinder of improved design, recently brought out by the Ingersoll Milling Machine Co., Rockford, Ill., grinds cutters from 5 to 30 inches in diameter with peripheral



Ingersoll Direct Motor-driven Cutter Grinder

faces from 1/2 to 7 inches in width. The principal feature of this grinder is that, after the cutter is once fastened on the spindle ready for grinding, the face and periphery of the cutter, as well as the corners of the teeth, are ground at a single setting. This grinding of cutters at a single setting is possible because the grinding-wheel spindle is always in the same vertical plane as the axis of the cutter, and at the same time can be set at different angles to the axis or rotated in an arc over the cutter. Cutters with angular faces may be ground, and the corners of cutters may be ground square, angular, or to a radius.

The cutter to be ground is carried on a spindle which revolves on ball bearings in a quill held vertically in the saddle. The saddle slides horizontally on ways on the machine base. It has 15 inches of adjustment on these ways, while the quill may be adjusted 4 inches vertically. The adjustments are obtained by means of handwheels at the front of

the machine, which are provided with graduations to thousandths of an inch. Through these handwheels, cutters of different sizes may be brought up to the proper position for grinding.

The grinding-wheel spindle is mounted on a slide which moves on ways on a U-shaped yoke. This yoke is pivoted on a horizontal axis, carrying the wheel-spindle over the cutter-spindle, but keeping it in the same vertical plane as the axis of the cutter-spindle. The yoke has a complete movement through 96 degrees for carrying the wheel-spindle from 3 degrees below horizontal to 3 degrees past the vertical. The yoke is mounted on anti-friction bearings and is counterbalanced. It can be rotated easily or clamped in position for grinding at any angle within its range.

The motor is built into the wheel-slide and drives the wheel-spindle direct. The grinding wheel is a disk 10 inches in diameter by 1/2 inch thick, which revolves across each tooth toward the cutting edge. Grinding is accomplished by moving the wheel along each tooth by means of a hand-lever.

Many types of cutters besides face mills can be ground in this machine, including cutters with solid shanks. The peripheral edges of the cutter teeth may be at any angle up to 96 degrees with the face. Arbor cutters may be ground, including keyway cutters, staggered-tooth channeling cutters, and formed cutters with curved teeth, either concave or convex, having a radius not exceeding 2 1/4 inches. Cutters with two parallel cutting faces, like the channeling types mentioned, require two settings.

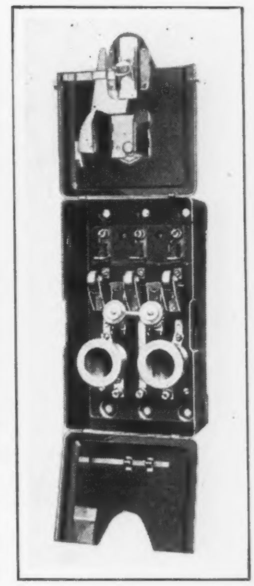
MORSE DRILLS FOR MANGANESE STEEL

It has always been considered more or less impractical to drill or otherwise machine high manganese steel. However, with the advent of a cobalt steel recently brought out by another company, the Morse Twist Drill & Machine Co., New Bedford, Mass., has been able to successfully drill railroad frogs having a chemical content of 1.08 per cent carbon and 10.04 per cent manganese, and a Brinell hardness of from 207 to 217. Drilling was accomplished with a drill of special structure designed to stand extreme torque and point pressure. Nine holes 1 1/2 inches deep were drilled through this railroad frog with one grinding of the drill. The Morse Twist Drill & Machine Co. is now prepared to make drills for work of this character, to specifications.

CUTLER-HAMMER MANUAL MOTOR STARTER

A manual across-the-line alternating-current motor starter recently designed by the Cutler-Hammer Mfg. Co., 1204 St. Paul Ave., Milwaukee, Wis., is shown in the accompanying illustration. This starter includes such features as overload cut-outs, giving complete motor protection; cadmium-plated double-break roller-type contacts; and a small-size safety dustproof case.

The roller-type contacts, by breaking the arc in two places, give several times the life of ordinary contacts. In addition, these rollers turn after each operation to present a new contact surface for the next operation. Complete motor protection is afforded during both the starting and the running periods. Thermal overload cut-outs provide the necessary time interval to take care of starting inrushes without shutting down the motor.



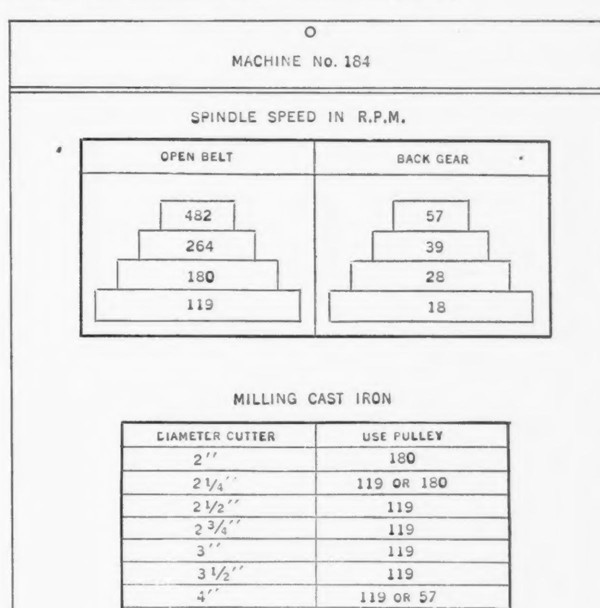
Cutler-Hammer Manual Motor Starter

The cover is made in two parts, which permits of opening the lower section only, for replacing fusible links in the thermal overload cut-outs. The cover can be opened only when the starter is in the "off" position and all current-carrying parts are "dead." This starter is known as the "Cutler-Hammer Bulletin 9115."

* * *

CHART OF CUTTING SPEEDS FOR MILLING

A chart has been worked out by the Combination Woodworking Machine Co., Chicago, Ill., for a number of milling machines in the company's plant, which shows the operator the speed at which the machine is to be run in order to obtain the proper cutting speed for cast iron, brass, steel, etc. Because the pulleys of each machine vary, it was necessary to work out a separate chart for each machine, the chart shown being applicable to one special machine. It was found that without a chart the operators frequently just guessed at the proper speed, which resulted in the machine and cutter being run much below their capacity.



MACHINE No. 184

SPINDLE SPEED IN R.P.M.

OPEN BELT	BACK GEAR
482	57
264	39
180	28
119	18

MILLING CAST IRON

DIAMETER CUTTER	USE PULLEY
2″	180
2 1/4″	119 OR 180
2 1/2″	119
2 3/4″	119
3″	119
3 1/2″	119
4″	119 OR 57
5″	57
5 1/2″	57
6″	57
6 1/2″	57
7″	57 OR 39
7 1/2″	39
8″	39

MILLING BR

Sample of Milling Speed Chart

Another New development—the

for all Brown & Sharpe No. 00 Aut

THE Automatic Rod Magazine is an important development for all shops where there is a field for one or many Brown & Sharpe No. 00 Automatics. It consists of a bar stock magazine with an arrangement for advancing the rods to the machine as they are needed.

When the rod on which the machine is working is used up, a clutch is engaged and the mechanism of the Rod Magazine is set in motion. A

CONTINUOUS MAXIMUM PRODUCTION

No time lost while machine is being restocked—idle machine time greatly reduced

Leaves operator free to devote entire time to operation of machine and requirements of work

Allows one operator to care for a greater number of machines

Increases net production

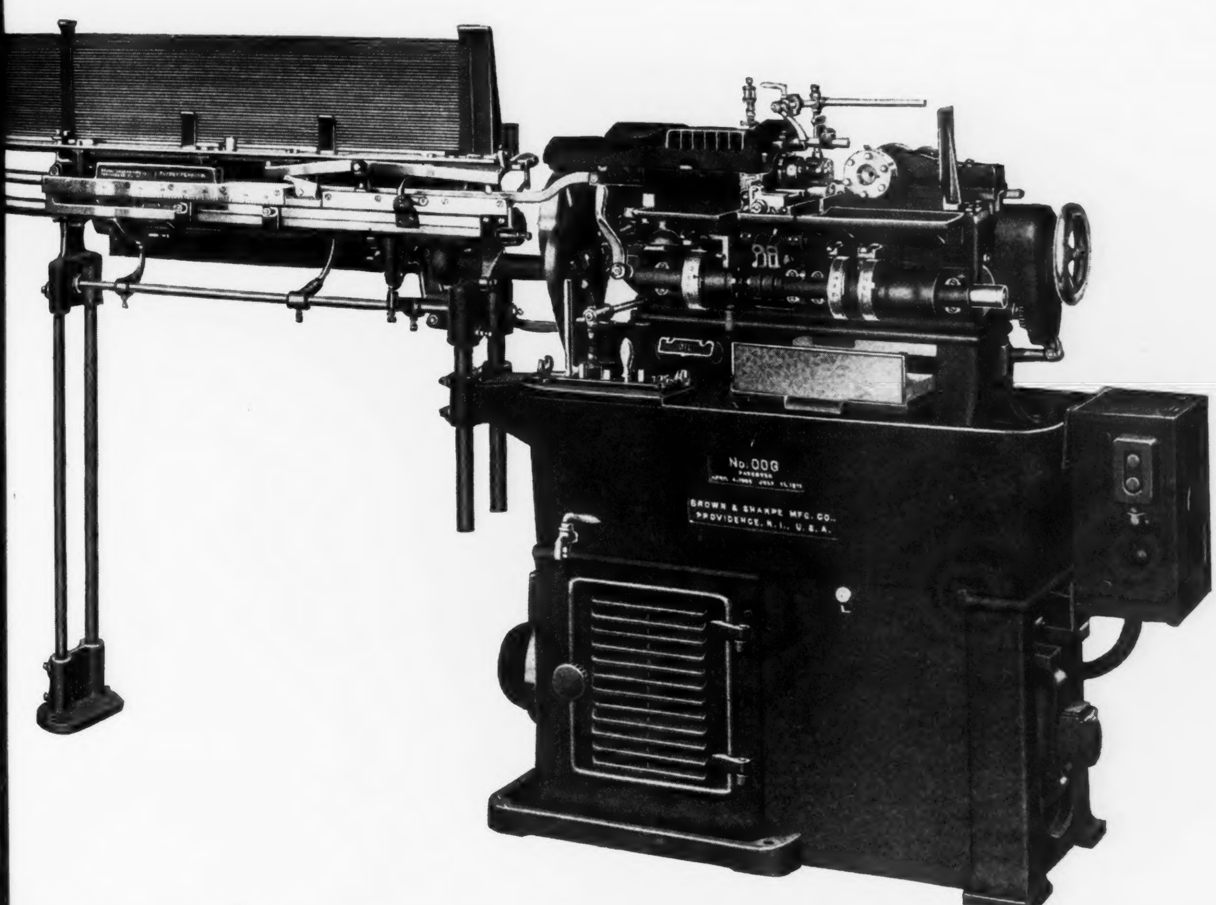
The Automatic Rod Magazine for all Brown & Sharpe No. 00 Automatic Screw—Screw Threading—Turret Forming—Cutting-Off Machines (Regular and High Speed)

the Automatic Rod Magazine

Automatic Screw Machines

new rod is automatically fed forward into the chuck, ejecting the remaining piece of the preceding rod, and the machine again is automatically set in operation.

Our Screw Machine Engineers will be glad to learn of your work and tell you where one or more No. 00 Machines, equipped with the Rod Magazine, may be used to advantage in your plant.

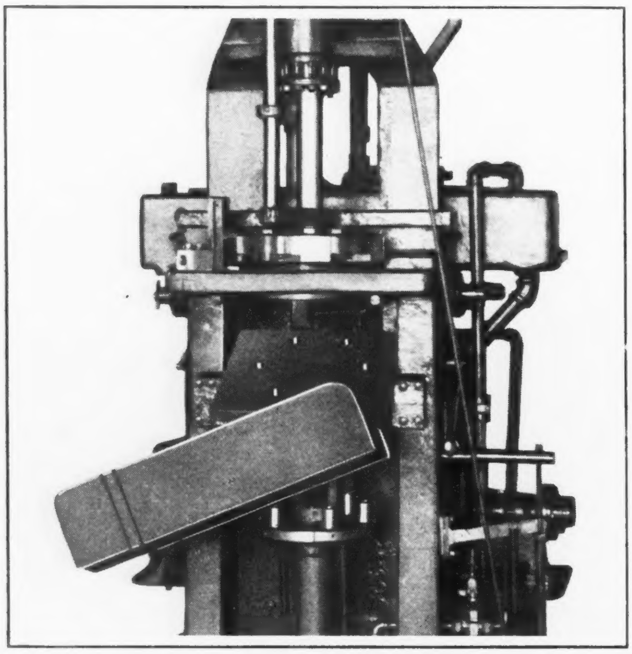


BROWN & SHARPE

BROWN & SHARPE MFG. CO. — B·S — PROVIDENCE, R. I., U. S. A.

BROACHING HOLES IN AUTOMOBILE CLUTCH PLATES

Six holes are broached simultaneously in automobile clutch plates by means of the equipment shown in the accompanying illustration, which was provided on a vertical hydraulic semi-automatic machine recently built by the American Broach & Machine Co., Ann Arbor, Mich. These holes have been drilled to a diameter of 3/4 inch when the clutch plates reach the broaching machine, and the operation in this machine consists of broaching away 1/16 inch of metal around approximately one-half the circumference of the holes for their entire length. With this equipment, the floor-to-floor time involved in broaching the six holes in the clutch plates averages 10 seconds, so that a total of 2160 holes may be broached per hour. With the exception of the equipment shown, the machine construction is the same as that described in April, 1926, MACHINERY.



Special Equipment Provided on a Vertical Broaching Machine for Simultaneously Broaching Six Holes in Clutch Plates

In the accompanying illustration, the machine is shown equipped with a lower bushing plate having six bushings in which the pilot shanks of the broaches rest when the broaches are in position for loading a clutch plate. Six holes in the tilting table on which the clutch plates are laid for the operation may also be seen. These holes provide clearance for the broaches. In an operation, after the work has been positioned on the table, the operator depresses a foot-treadle, which causes all six broaches to pass upward simultaneously through the holes in the work and become automatically connected to the pull-head. Then after the operation of a second treadle, the pull-head draws all six broaches through the work until the upper end of the stroke is reached, at which time the finished work falls on a chute and slides into a receptacle. The ram next returns to its low position, the pull-head releases the broaches and the latter fall down into the bushings of the bushing plate ready to receive the next piece of work.

A single-broach machine equipped with an indexing fixture to permit the broaching of six holes at one positioning of the work in the machine, was also recently constructed by the same company. This machine operates similarly to the multiple-broach machine just described, with the exception that the work-table swings forward after each hole has been machined, so that the broach may be returned to its lower position without passing through the work. Then the work is indexed and the table again swung into place to bring the next hole in line for the broach. It will be apparent that in broaching six holes there are five indexings of the work. The movement of the broaches is controlled through two foot-treadles in the fashion already outlined. In a single-broach operation of this kind, a production of 100 parts or 600 holes can be averaged per hour.

* * *

PERSONALS

A. W. SCHNEIDER, works manager of the Reed-Prentice Corporation, Worcester, Mass., and F. W. MCINTYRE, vice-president, have been elected members of the board of directors.

WILLIAM MCCORMICK, formerly Pittsburgh sales manager of the Niles Tool Works Co. and the Pratt & Whitney Co., is now western sales representative of Leeds, Tozzer & Co., Inc., 75 West St., New York City.

JACOB F. SAVELA has been appointed welding service manager of the Detroit district for the Lincoln Electric Co., Cleveland, Ohio. Mr. Savela is a graduate of the University of Michigan and has had a wide practical experience.

HENRY WARREN REDING has been appointed textile engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in charge of that company's activities in connection with the textile industry. He will be located at East Pittsburgh.

EDWIN B. PEET, who was connected with the E. W. Bliss Co., Brooklyn, N. Y., until a few years ago, has again become associated with that company in its sales department and will devote himself principally to the sale of can making machinery and allied products.

H. B. HAZERODT has resigned as manager of the Detroit branch of the Black & Decker Mfg. Co., Towson, Md., to take up another line of work, and J. H. WALKER, who has been a salesman in that territory for almost five years, has been appointed manager in Mr. Hazerodt's place.

R. C. BIRD has been appointed traveling sales manager of the D. O. James Mfg. Co., Chicago, Ill., maker of all types of speed reducers and cut gearing. Mr. Bird was formerly with the Chain Belt Co. of Milwaukee, and has had about twenty years' experience with power transmission equipment.

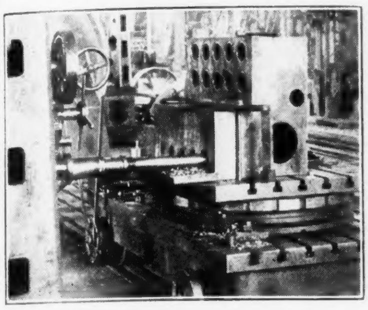
ROBERT K. GREAVES has been appointed Detroit district sales manager of tool and special steels and metal-cutting saws for Henry Disston & Sons, Inc., of Tacony, Philadelphia, Pa. His headquarters will be at 620 E. Hancock St., Detroit, Mich. Mr. Greaves has been engaged in the tool steel business for over twenty-seven years.

CARL F. SCOTT, manager of building equipment sales of the General Electric Co., Schenectady, N. Y., has entered the employ of the Gurney Elevator Co., New York City, as assistant sales manager. Mr. Scott had been connected with the General Electric Co. since 1908, having had charge of the sale of electric equipment for elevators.

RALPH N. SOURBECK, formerly sales engineer of the Clarkson Coal & Dock Co., Cleveland, Ohio, is now affiliated with the Cleveland Duplex Machinery Co., Inc., in charge of the surplus machinery department. Mr. Sourbeck will devote his time to the purchase and liquidation of industrial plants and supervision of the rebuilding of machine tools.

H. W. CABLE, designer and engineer, formerly with the Trundle Engineering Co. and the Cleveland Automatic Machine Co., has opened offices as consulting engineer on machine and tool design, special production equipment, production cost estimating, etc., in the metal-working field, with headquarters at 5716 Euclid Ave., Cleveland, Ohio.

TYPICAL PERFORMANCE

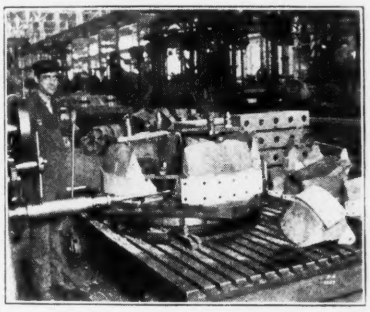


Total time including setting 150 hours, 42 min.

Pump Body for 24,000 Bbl. Oil Pipe Line Pump Machine clamped on 4 ft. Turn Table. Material: Open Hearth Steel 1.30% Carbon. Size: 23" x 29½" x 36½". Weight: 5700 lbs.

Drill	& Tap—	10	Holes	1¼"	dia.	x 1½" deep
"	"	12	"	1⅛"	"	x 1⅜" "
"	"	80	"	1"	"	x 1¼" "
"	"	38	"	⅞"	"	x 1⅛" "
"	"	18	"	¾"	"	x 1" "
"	Bore	1	"	3½"	"	x36½" "
"	"	5	"	3½"	"	x26" "
"	"	5	"	3½"	"	x10" "
"	"	20	"	4"	"	x 7½" "
"	"	10	"	2⅜"	"	x 2" "
"	"	10	"	2¼"	"	x 4" " (See note A)
"	"	20	"	3⅛"	"	x 2½" "
"	"	1	"	8½"	"	x33¼" "

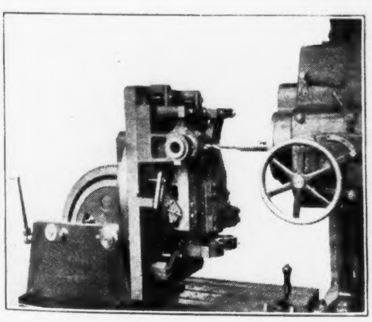
Note "A"—These holes were drilled at different angles to the horizontal and vertical planes which required six different angular settings of the table.



20 BUCKETS DRILLED IN 14¼ HOURS

Floor to Floor Time
Every Pair of Holes at a Different Angle

Four ditcher buckets, each weighing 85 pounds, mounted on a 4' turntable. Twelve 13/16" holes drilled thru 1⅛" material. Two 1" holes drilled thru ¾" material. Drilled from 8 positions with one clamping.



A Ryerson Horizontal, drilling bearings for the car body of an excavator crane. Work mounted on a horizontal tilting and revolving table, tilted full 90 degrees.

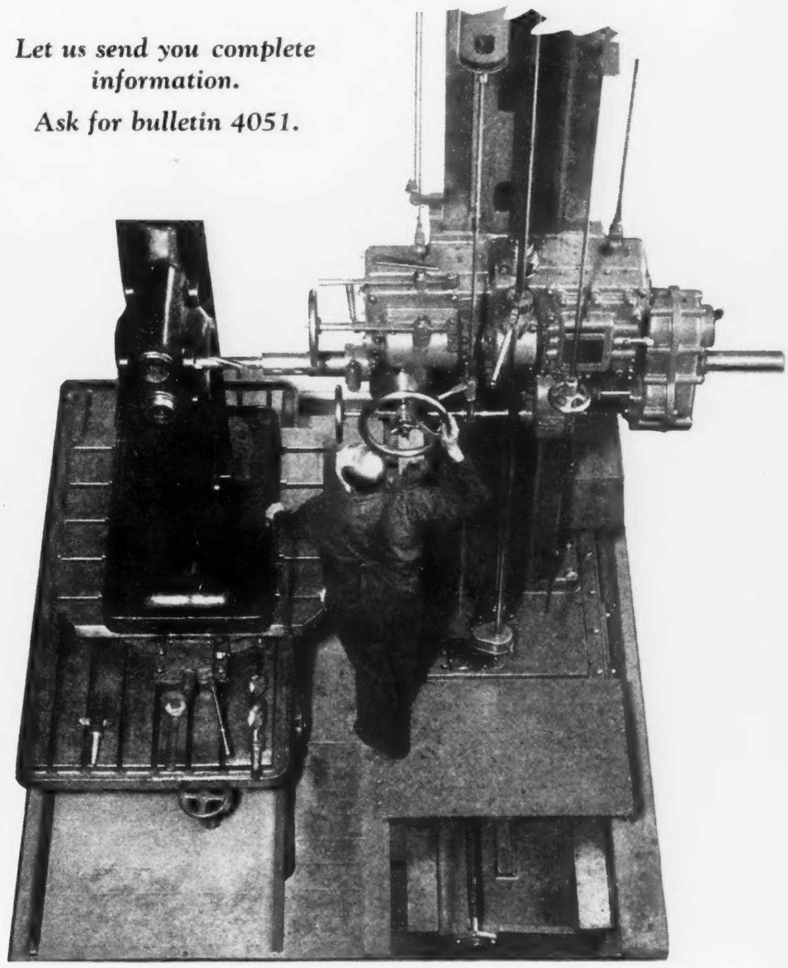
Every Move Counts

The operator of a Ryerson Horizontal can plant his feet in one spot and bring the work to him. He does not have to climb around and over odd-shaped castings all day. His energy goes into additional work and he is able to keep up production as the day grows.

Anything in the shop—small pieces on a production schedule, or the largest casting can be economically handled by a horizontal. The unusual vertical travel of the spindle and the rolling work table gives this machine a capacity unequaled by any other type of drilling machine and thus eliminates frequent resetting of work.

Let us send you complete information.

Ask for bulletin 4051.



JOSEPH T. RYERSON & SON INC.
Established 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Houston, Tulsa, Los Angeles, San Francisco, Denver, Minneapolis, Duluth.

Drill it Horizontally

J. W. INNES, formerly of the Durant Motors, Ltd., and Gray Dort Motors, and more recently superintendent of the Kelvinator Co. of Canada, Ltd., has now joined the Toronto staff of the Arthur Jackson Machine Tool Co., 32 Front St., W., Toronto 2, Can., as sales representative, and will cover the Hamilton and Niagara Peninsula District in Ontario.

EDWARD E. MARBAKER has been appointed to an industrial fellowship recently established by the Whiting Corporation of Harvey, Ill., at the Mellon Institute of Industrial Research, Pittsburgh, Pa. The fellowship was established for the purpose of conducting research on cast iron, and the results of the investigations will be published for the benefit of the foundry industry.

H. J. HAIR, recently sales engineer handling railroad sales for the Whiting Corporation, Harvey, Ill., has been appointed manager of railroad sales of the Watson-Stillman Co. Mr. Hair has had wide experience in railroading and railroad supplies, and has held various positions on railroads. His headquarters will be at the main office of the company—75 West St., New York City.

C. Irving Dwinell

JUSTIN G. SMEBY has been recently appointed welding engineer at the South Philadelphia Works of the Westinghouse Electric & Mfg. Co. Mr. Smeby started with the company in 1922 as an apprentice in the South Philadelphia plant, and was later transferred to the tool design division. In 1925 he entered the turbine engineering department, where he remained until his recent appointment.

C. IRVING DWINELL has been appointed manager of the Boston branch of the United States Electrical Tool Co., located at 514 Atlantic Ave., Boston. After graduating from Tufts College, Mr. Dwinell became connected with the General Electric Co. as electrical engineer. He later served the Cleveland Union Terminal Co. in the same capacity, and then became assistant purchasing agent of the B. F. Goodrich Rubber Co., Akron, Ohio. Previous to his present appointment, he was connected with the General Electric Co. as sales engineer, with headquarters at Providence, R. I.

J. F. CARLSON of the accounting department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has received over $1000 in awards for ideas for improvements in systems and production methods. Eighty-five of the suggestions made by Mr. Carlson have been adopted by the company. Most of the improvements concern switchboards, as Mr. Carlson has spent twelve years working on them and is thoroughly familiar with them.

R. M. HUSBAND, who has been in charge of the advertising department of the Cincinnati Bickford Tool Co., Cincinnati, Ohio, for the last two years, has left the company to take up similar duties with the National Machinery Co., Tiffin, Ohio. He will be succeeded by R. N. Piper. R. L. Rickwood, who has been supervisor of design of the Cincinnati Bickford Tool Co., has left to become mechanical superintendent of the new Cincinnati Enquirer Building. He will be succeeded by Thomas Addison, formerly with the Cincinnati Planer Co. At a farewell dinner given by the officers and directors of the Cincinnati Bickford Tool Co. to Mr. Husband and Mr. Rickwood, they were presented with attractive desk sets, with gold pens, as a token of appreciation.

O. W. YOUNG, formerly with the western division sales office of the Hyatt Roller Bearing Co., has been appointed chief engineer of the company and is taking up his new duties at the headquarters in Newark, N. J. Mr. Young has been connected with the Hyatt Roller Bearing Co. since 1915, when he joined the company as sales engineer. After several years in that capacity, he was put in charge of all engineering activities of the western division, and during the last two years has been assistant manager of that division in charge of sales covering the tractor and agricultural equipment industry. Before joining the Hyatt organization, he was engaged in consulting engineering work in the Northwest, covering automotive, tractor, and industrial work.

OBITUARIES

LEROY PARDEE NEEDHAM, district manager of Wheelock, Lovejoy & Co., Inc., Chicago, Ill., died following an operation at the Wesley Hospital on March 24. Mr. Needham was born in Coatesville, Pa., May 24, 1890. In 1915, he graduated in civil engineering from the Pennsylvania State College, and afterward served in the Ordnance Department during the war as inspector of steels. In 1916, he became affiliated with Wheelock, Lovejoy & Co., Inc., in the Cleveland branch, and except for the period during the war when he served the Government, he worked as a salesman in the Cleveland branch until 1920, when he was appointed district manager of the western territory, with headquarters in Chicago. Mr. Needham's sudden death came as a great shock to his many friends. He is survived by his wife and two children.

A. L. BROOMALL, manager of the renewal parts engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died on April 10 of pneumonia, at his home in Wilkinsburg. Mr. Broomall was born on June 27, 1884, in Lenni, Delaware Co., Pa. He graduated from Lehigh University in 1906 with the degree of Bachelor of Science in electrical engineering. Immediately after graduation, he entered the graduate students' course of the Westinghouse organization and continued to work for that company until his death.

His advancement as an engineer was rapid. His first important work was on the installation of the first electric locomotives on the New York, New Haven and Hartford Railroad. From 1911 to 1915 he had charge of the design of electrical vehicle motors. He was appointed section head of the direct-current motor section in 1915, and in 1922 was transferred to the renewal parts engineering department as engineer in charge, later becoming manager of the department, which position he held when he died. He was a member of the American Institute of Electrical Engineers and the American Electric Railway Association. He is survived by his wife and two daughters.

TRADE NOTES

BROWN INSTRUMENT CO. has moved its Detroit branch into larger quarters at 576 Maccabee Bldg., Detroit, Mich.

TRICO FUSE MFG. CO., Milwaukee, Wis., has removed its Pittsburgh office to new and larger quarters at 405 Penn Ave. William A. Bittner is in charge of the office.

DOEHLER DIE-CASTING CO., Brooklyn, N. Y., announces the removal of its executive offices from Brooklyn to 386 Fourth Ave., corner of Twenty-seventh St., New York City.

BLACK & DECKER MFG. CO., Towson, Md., announces that its Detroit branch has been moved to larger quarters at 11501 Woodward Ave., Detroit. J. H. Walker is manager of the Detroit branch.

ALFRED HERBERT, LTD., Coventry, England, manufacturer, importer and exporter of machine tools and small tools, has appointed H. W. Petrie, Ltd., of Toronto, Canada, Canadian agent for the company.

STUEBING COWAN CO., Cincinnati, Ohio, has appointed Leeds, Tozzer & Co., Inc., 75 West St., New York City, distributors in the railway field of the line of Stuebing Cowan hand and electric lift trucks and steel-bound platforms.

FARMER LUBRICATION SYSTEMS, INC., has been purchased and reorganized by a Battle Creek, Mich., corporation, to be known as the BATTLE CREEK FARMER LUBRICATION DEVICES. The company has been moved to Battle Creek.

KENT MACHINE CO., 1320 Front Ave., N.W., Grand Rapids, Mich., which is engaged in contract machine work and the building of special machines, tools, and dies, has erected a new shop, of modern fireproof construction, with a floor space of about 60 by 120 feet.

LEIPZIG TRADE FAIR, INC., has moved its American headquarters from 630 Fifth Ave., New York City, to the Salmon Tower Building, 11 W. 42nd St., New York. The New York representatives of the fair will give every assistance to exhibitors and buyers visiting Leipzig.

MODERN REAMER SPECIALTY CO., of Millersburg, Pa., maker of "Red Line" reamers, has changed its name to the RED LINE REAMER CO. This change was made because of the confusion which has existed due to the difference in the name of the company and the name of the product.

FELLOWS GEAR SHAPER CO., 78 River St., Springfield, Vt., has appointed two new agents on the Pacific Coast. C. F. Bulotti Machinery Co., with office in San Francisco, will represent the company in Northern California, and Reeves & McBride, with office in Los Angeles, will represent the company in Southern California.

GUNITE CORPORATION, Rockford, Ill., is a newly incorporated company which will manufacture and market the product "Gunite," a gun iron alloy which has heretofore been made in the Gunite Division of the Rockford Malleable Iron Works. Duncan P. Forbes is president, and John A. Forbes, secretary and treasurer of the new corporation.

CITY MACHINE & TOOL WORKS, Dayton, Ohio, announces the purchase of all rights to the Peerless gear chamfering machine, formerly manufactured by the Peerless Machine Co. of Muncie, Ind. Sales will be under the direction of the City Machine & Tool Works' and the National Broach Co.'s selling organizations—the latter company being an affiliation of the former.

BRYANT ELECTRIC CO., Bridgeport, Conn., has made arrangements to purchase the plant, trademarks, patents and processes of the HEMCO ELECTRIC MFG. CO., which has been making molded sockets, plates, and other composition parts for electrical purposes for many years. It is the plan of the Bryant Electric Co. to expand this line and develop many new composition devices.

CANADIAN OHMER, LTD., has been granted a Dominion charter for the purpose of acquiring the business of Canadian Taximeters, Ltd., and of marketing in Canada all the products manufactured by the Ohmer Fare Register Co. of Dayton, Ohio. Headquarters have been established at 3510-12 St. Laurence Blvd., Montreal, Canada. Branch offices will later be located in Toronto and Winnipeg.

BILLINGS & SPENCER CO., Hartford, Conn., has appointed W. R. Vorhees & Co., San Francisco, Cal. and Seattle, Wash., representatives of the company in Montana, Colorado, Wyoming, Idaho, Utah, Nevada, Washington, Oregon, California, Arizona, New Mexico, and El Paso, Tex. They will handle the entire Billings line of wrenches, hammers, pliers, clamps, dogs, etc., as well as special forgings and machinery.

WRIGHT MFG. CO., Lisbon, Ohio, manufacturer of chain hoists, trolleys, and cranes, announces the sale of its business and trade name to the AMERICAN CHAIN CO., INC., with executive offices in Bridgeport, Conn. No change is anticipated in the policies or sales organization of the Wright Mfg. Co. H. F. Wright and W. F. Wright will continue in their respective divisions of sales and production of Wright products.

FOOTE BROS. GEAR & MACHINE CO., 232-242 N. Curtis St., Chicago, Ill., has appointed the Mideke Supply Co., 100 E. Main St., Oklahoma City, Okla., representative of the IXL line of speed reducers, gear products, and general transmission machinery in Oklahoma City and vicinity. Bentley & Holmgren, Room 406, Court Exchange Bldg., Bridgeport, Conn., have been appointed representatives of the company in Connecticut and western Massachusetts.

R. D. NUTTALL CO., Pittsburgh, Pa., announces that the commercial activities of the company from now on will be handled by and through the parent company, the Westinghouse Electric & Mfg. Co., effective April 1. J. E. Mullen, formerly assistant sales manager of the R. D. Nuttall Co., will head the new commercial organization, with offices at the Nuttall plant, McCandless Ave. at Butler St., Pittsburgh, Pa. All inquiries should be addressed to the nearest Westinghouse district office.

PAUL MURCHISON CO., INC., has been organized by T. P. Steinmetz, formerly sales promotion manager of the Commercial Investment Trust Corporation, to act as sales representative and New York distributor in the Metropolitan territory for manufacturers of automotive products. The main office of the new company is at 280 Broadway, New York City, and this office will also be available as New York headquarters to manufacturers whose products are handled by the company. T. P. Steinmetz is president of the company.

J. H. WILLIAMS & CO., Buffalo, N. Y., and the HUSKY WRENCH CO., Milwaukee, Wis., announce that they have made a reciprocal sales arrangement by means of which a unique line of combination wrench sets composed of Williams' "Superrenches" and Husky socket wrenches is offered to the trade. This arrangement enables each company to merchandise in combination sets, the other company's chrome-alloy steel open-end or socket wrenches. The combination is made for selling purposes only and does not affect the management or ownership of either company; it is limited to the tools constituting the sets mentioned.

GEARS AND FORGINGS, INC., Cleveland, Ohio, held a general sales meeting of the sales and engineering forces of the company in Cleveland March 29 and 30, the number attending the meeting being approximately thirty, with F. W. Sinram, president, conducting the meeting. The recent consolidation of several well-known concerns in the gearing field has brought together in one organization the largest group of experienced sales and engineering executives ever working in the gear industry as one group.

The Sales and Engineering Forces of Gears and Forgings, Inc., at Their Recent General Sales Meeting in Cleveland, with F. W. Sinram, President, in the Center of the Front Row

MADISON-KIPP CORPORATION, Madison, Wis., has acquired by purchase from the Detroit Lubricator Co., Detroit, Mich., the latter company's mechanical force-feed lubricator division, except the force-feed locomotive type and the hydrostatic types of lubricator. The Madison-Kipp Corporation acquires all equipment, patterns, designs, and inventory used in the production of the Detroit models G, JT, and JTS force-feed lubricators. The physical assets will be shipped to Madison, and the new line will be handled at the factory and offices in Madison. This transfer is an outright purchase, and in no way affects the capital stock or management of the two companies.

PRODUCTO MACHINE CO., Bridgeport, Conn., has purchased all the assets of the BILTON MACHINE TOOL CO. of that city. The same organization that has operated the Bilton Machine Tool Co. during the recent receivership will continue to manage and operate the Producto Machine Co. The officers of the company are William J. Grippin, chairman of the board; N. M. Marsilius, president and general manager; Frederick Rhodes, first vice-president; E. A. Harper, vice-president in charge of Detroit sales; E. G. Rogers, vice-president in charge of foundry sales; A. J. Cummings, vice-president in charge of eastern machinery sales; George H. Weber, secretary, treasurer, and assistant general manager; and R. S. Lathe, assistant secretary and assistant treasurer. The principal product of the company is the Producto-matic milling machine; in addition cam, gear, and hand milling machines, as well as die sets, special cutters, and gray iron castings, are manufactured.

WAGNER ELECTRIC CORPORATION has removed its New York City branch sales office from 50 Church St. to Suite 1110, 30 Church St. The New York City Service Station remains at 321 W. 54th St.

COMING EVENTS

MAY 7-11—Sixteenth annual meeting of the Chamber of Commerce of the United States at Washington, D. C.

MAY 10-11—Second annual conference on Steel Treating at Purdue University, Lafayette, Ind. For further information address Engineering Extension Department, Purdue University.

MAY 14-17—Spring meeting of the American Society of Mechanical Engineers in Pittsburgh, Pa. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 14-18—Twenty-first annual exhibit of machines, equipment, materials and supplies for foundries and the allied industries in the Commercial Museum, Philadelphia, Pa. In conjunction with the exhibit, the thirty-second annual convention of the American Foundrymen's Association will be held. C. E. Hoyt, manager of exhibits, 140 S. Dearborn St., Chicago, Ill.

MAY 23-25—Annual spring meeting of the Associated Machine Tool Dealers at Granville, Ohio. E. P. Essley, secretary, 555 Washington Blvd., Chicago, Ill.

MAY 25-26—Fifth annual convention of the National Association of Foremen to be held at Canton, Ohio. E. H. Tingley, secretary, National Association of Foremen, 1249 U. B. Bldg., Dayton, Ohio.

JUNE 4-6—Fourteenth annual convention of the American Association of Engineers at El Paso, Tex.; headquarters, Hotel Hussman. Chairman of local committee, L. M. Lawson, First National Bank, El Paso, Tex. Further information can be obtained from the secretary, M. E. McIver, 63 E. Adams St., Chicago, Ill.

JUNE 14-16—Oil and Gas Power meeting of the American Society of Mechanical Engineers at State College, Pa. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 20-27—Annual meeting of the Mechanical Division V of the American Railway Association in Atlantic City, N. J.

JUNE 20-27—Annual convention and exhibition of the Railway Supply Manufacturers' Association in Atlantic City, N. J. Secretary-treasurer, J. D. Conway, 1841 Oliver Bldg., Pittsburgh, Pa.

JUNE 25-29—Annual meeting of the American Society for Testing Materials at Atlantic City, N. J.; headquarters, Chalfonte - Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

JUNE 25-29—Annual meeting of the Society for the Promotion of Engineering Education at the University of North Carolina, Chapel Hill, N. C. For further information, address Dean Braune, University of North Carolina.

JUNE 26-29—Semi-annual meeting of the Society of Automotive Engineers at the Chateau Frontenac, Quebec, Canada. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JUNE 28-29—Aeronautic Division meeting of the American Society of Mechanical Engineers at Detroit, Mich. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 5-22—Fourth Machine Tool and Engineering Exhibition to be held at Olympia, London, England.

SEPTEMBER 12-14—Annual convention of the American Railway Tool Foreman's Association in Chicago, Ill.; headquarters, Hotel Sherman. Secretary and treasurer, F. A. Armstrong, 564 W. Monroe St., Chicago, Ill.

SEPTEMBER 17-20—Second national meeting of the Fuels Division of the American Society of Mechanical Engineers to be held in Cleveland, Ohio. Chairman of Fuels Division, Victor J. Azbe, American Society of Mechanical Engineers, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

STEAM TABLES. 18 pages, 4 3/4 by 7 inches. Published by the Superheater Co., 17 E. 42nd St., New York City.

This is the seventh edition of a pamphlet containing tables giving the properties of saturated and superheated steam from 1 to 3300 pounds absolute pressure.

TRADEMARKS. 48 pages, 6 by 9 inches. Published by Richards & Geier, 277 Broadway, New York City.

This is the fourth edition of a little pamphlet containing useful information on trademarks and trade names, including registration in the United States and abroad, rightful users of trademarks, duration of right, actions for infringement, schedule of charges, etc.

EFFECTIVE BUSINESS LETTERS. By Edward H. Gardner and Robert R. Aurner. 385 pages, 6 by 8 1/2 inches. Published by the Ronald Press Co., 15 E. Twenty-sixth St., New York City. Price, $3.

This is a revised edition of a book intended to assist the writer of business letters in developing his own powers of expression through principle and practice. In addition to cultivating the ability to write letters that are forceful, human, and tactful, it gives information on sales psychology, on handling business situations, and on the practical organization of correspondence activities. It takes up all types of sales correspondence, including credit and collection letters, orders, acknowledgments, adjustments, claims, and everyday routine. Many sample letters are included applicable to different conditions.

BILLS OF LADING. By Ernest W. Hotchkiss. 287 pages, 6 by 8½ inches. Published by the Ronald Press Co., 15 E. Twenty-sixth St., New York City. Price, $5.

Dealing with a subject that is of prime interest to all concerned with traffic, whether in the employ of the railroads or industrial concerns, this is practically the first book of its kind that has appeared in the last twenty-five years, a period that has witnessed many important developments in the field of transportation. It presents a clear and concise explanation of the law concerning various types of bills of lading and contracts of shipment, and brings together in one handy volume references to related statutes, court decisions, and the forms, rules, and regulations of the carriers as approved by the Interstate Commerce Commission, all of which are a part of the contract of shipment. The author of this volume is a member of the Michigan bar and assistant treasurer of the Grand Trunk Railway System.

NEW CATALOGUES AND CIRCULARS

VARIABLE-SPEED TRANSMISSION. Reeves Pulley Co., Columbus Ind. Booklet briefly describing the major features of the new Reeves variable-speed transmission.

RIVETERS. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Circular entitled "Rivet It," illustrating the use of Hanna riveters in construction work.

LIGHTING EQUIPMENT. Crouse - Hinds Co., Syracuse, N. Y. Catalogue 310, illustrating and giving complete data on various designs of floodlights and industrial lighting units.

HEAT-TREATING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave. Philadelphia, Pa. Circular 8 in a heat-treating series, entitled "Controlling Internal Structure by the Hump Method."

CLUTCHES. Brown Engineering Co., 133 N. 3rd St., Reading, Pa. Bulletin 25, illustrating and describing "Mule Pull" clutches (types D and ER). The bulletin contains tables of list prices, dimensions, and repair parts.

AUTOMATIC LATHES. Jones & Lamson Machine Co., Springfield, Vt. Production report of a job, consisting of the machining of transmission sliding gears at the rate of fifty-six per hour on the Fay automatic lathe.

FLEXIBLE SHAFTS AND EQUIPMENT. N. A. Strand & Co., 5001-5009 N. Lincoln St., Chicago, Ill. Catalogue containing 48 pages, covering several new types of grinding and polishing machines and attachments.

HOLLOW-MILLS. Reisinger Machine Tool Corporation, 839 Lake Ave., Rochester, N. Y. Catalogue 8, illustrating and describing Reisinger quick-adjustable hollow-mills. Specifications and prices are included for the various sizes.

VENTILATING EQUIPMENT. American Blower Corporation, Detroit, Mich., is issuing a pictorial sheet entitled, "Ventilation News," which illustrates different uses of ventilating equipment and contains suggestions for improving ventilation in various fields.

AIR COMPRESSORS. Ingersoll-Rand Co., 11 Broadway, New York City. 140-page catalogue entitled "100 and 1 Ways to Save Money with Portable Compressors," containing comparative cost data on Ingersoll-Rand portable air compressors and air-operated tools.

SPEED-REDUCING TRANSMISSION. Morrison Machine Co., 204 Van Houten St., Paterson, N. J. Catalogue of Morrison speed-reducing transmission, illustrating and describing the details of construction and giving complete specifications of the various models.

DIES AND TOOLS. Standard Die & Tool Co., Inc., Eighth and Carlton Sts., Berkeley, Cal., has just brought out a new publication called "The Toolmaker," which will be issued monthly and will contain news and data intended to assist manufacturers in solving their tool problems.

ELECTRIC FURNACES. Ajax Electrothermic Corporation, Division of the Ajax Metal Co., Trenton, N. J. Bulletin 5, describing the principle of operation of the Ajax - Northrup high-frequency motor-generator type of electric furnaces. The bulletin contains a partial list of users of these furnaces.

NICKEL CAST IRON. International Nickel Co., Inc., 67 Wall St., New York City. Circular entitled "Insuring Dependable Properties in Gray Iron Castings by the Use of Nickel," containing a brief presentation of the improved characteristics of nickel iron castings, with special reference to machineability.

PUNCHING AND SHEARING MACHINES AND TOOLS. Cleveland Punch & Shear Works Co., Saint Clair and E. 40th St., Cleveland, Ohio. Circular entitled, "Fabricating Follies of 1928," pointing out the disadvantages of using homemade small tools and illustrating and describing the Cleveland line of punching and shearing machines.

ELECTRICAL EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GEA-137A, 467A, 808A, and 914, illustrating and describing, respectively, synchronous motors for mounting on compressor shafts; automatic starters for slip-ring motors; fan-cooled induction motors; and limit switches. Circulars GEA-797 and 921, dealing, respectively, with the repair of commutators of railway and industrial-haulage motors, and better lubrication for railway motors.

PIPE THREADING EQUIPMENT. Oster Mfg. Co., Cleveland, Ohio. Catalogue 36, illustrating pipe threading tools and equipment and their use. The line includes die-stocks, portable power machines, stationary power machines, light hand machines, cutting tools, and pipe vises. Attention is called to two new products that are shown in the catalogue—the Oster 4-inch "Power Boy" (No. 414) and the Oster 4-inch cutter, which have recently been added to the line.

DIE CUSHIONS FOR POWER PRESSES. Marquette Tool & Mfg. Co., 1904 N. Kilbourn Ave., Chicago, Ill. General catalogue No. 4, illustrating Marquette pneumatic die cushions and their application to various types of power presses. Complete specifications are given for the various types. In addition to the catalogue information, the book contains engineering data, including tables of weights of steel and iron sheets and plates, aluminum sheets, copper and brass sheets, zinc sheets, and tin plate; width of strips for staggered cuts; areas of drawn shells; blank diameters of cylindrical shells; press capacities; pressure required for punching and shearing steel and brass plate; ultimate strength of metals; approximate die clearance between punch and die, etc.